INTERNATIONAL SEARCH REPORT

International Application No
PCT/FR 96/01904

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H02K37/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H02K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR 2 201 575 A (DE VALROGER; LAVET) 26 April 1974 see page 4, line 24 - page 7, line 1; figures 1,2,8,9 see page 12, line 36 - page 13, line 35	1,5-10
A	WO 92 22122 A (MOVING MAGNET TECH) 10 December 1992 cited in the application see abstract	1
A	NL 7 308 770 A (INDUSTRIE KOOT) 24 December 1974 see figure 1	1
A	GB 199 424 A (HOLLISTER; VANDERVELL & CO) 22 June 1923 see figure 5	2

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 March 1997	21. 03. 97

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl, Fax (+ 31-70) 340-3016	Zanichelli, F

Form PCT/ISA/210 (second sheet) (July 1992)

RAPPOI DE RECHERCHE INTERNATI ALE

1 inde Internationale No
PCT/FR 96/01904

A. CLASSEMENT DE L'OBJET DE LA DEMANDE
CIB 6 H02K37/14

Selon la classification internationale des brevets (CIB) ou à la fois selon la classification nationale et la CIB

B. DOMAINES SUR LESQUELS LA RECHERCHE A PORTE

Documentation minimale consultée (système de classification suivi des symboles de classement)
CIB 6 H02K

Documentation consultée autre que la documentation minimale dans la mesure ou ces documents relèvent des domaines sur lesquels a porté la recherche

Base de données électronique consultée au cours de la recherche internationale (nom de la base de données, et si cela est réalisable, termes de recherche utilisés)

C. DOCUMENTS CONSIDERES COMME PERTINENTS

Catégorie *	Identification des documents cités, avec, le cas échéant, l'indication des passages pertinents	no. des revendications visées
A	FR 2 201 575 A (DE VALROGER; LAVET) 26 Avril 1974 voir page 4, ligne 24 - page 7, ligne 1; figures 1,2,8,9 voir page 12, ligne 36 - page 13, ligne 35	1,5-10
A	WO 92 22122 A (MOVING MAGNET TECH) 10 Décembre 1992 cité dans la demande voir abrégé	1
A	NL 7 308 770 A (INDUSTRIE KOOT) 24 Décembre 1974 voir figure 1	1
A	GB 199 424 A (HOLLISTER; VANDERVELL & CO) 22 Juin 1923 voir figure 5	2

☐ Voir la suite du cadre C pour la fin de la liste des documents

☒ Les documents de familles de brevets sont indiqués en annexe

* Catégories spéciales de documents cités:

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"T" document ultérieur publié après la date de dépôt international ou la date de priorité et n'appartenenant pas à l'état de la technique pertinent, mais cité pour comprendre le principe ou la théorie constituant la base de l'invention

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"&" document qui fait partie de la même famille de brevets

1

Date à laquelle la recherche internationale a été effectivement achevée	Date d'expédition du présent rapport de recherche internationale
17 Mars 1997	21. 03. 97

Nom et adresse postale de l'administration chargée de la recherche internationale	Fonctionnaire autorisé
Office Européen des Brevets, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl, Fax (+ 31-70) 340-3016	Zanichelli, F

Formulaire PCT/ISA/210 (deuxième feuille) (juillet 1992)

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : **H02K 37/14**	**A1**	(11) International Publication Number: **WO 00/45501** (43) International Publication Date: 3 August 2000 (03.08.00)

(21) International Application Number: PCT/IT99/00388

(22) International Filing Date: 25 November 1999 (25.11.99)

(30) Priority Data:
RM99A000066 28 January 1999 (28.01.99) IT

(71) Applicant *(for all designated States except US)*: MICRONASA DI PATARCHI ALBERTO [IT/IT]; Viale della Marina, 3, I–00122 Ostia Lido (IT).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: PATARCHI, Alberto [IT/IT]; Viale della Marina, 3, I–00122 Ostia Lido (IT).

(74) Agent: BELLOMIA, Paolo; Bugnion S.p.A., Via Vittorio Emanuele Orlando, 83, I–00185 Roma (IT).

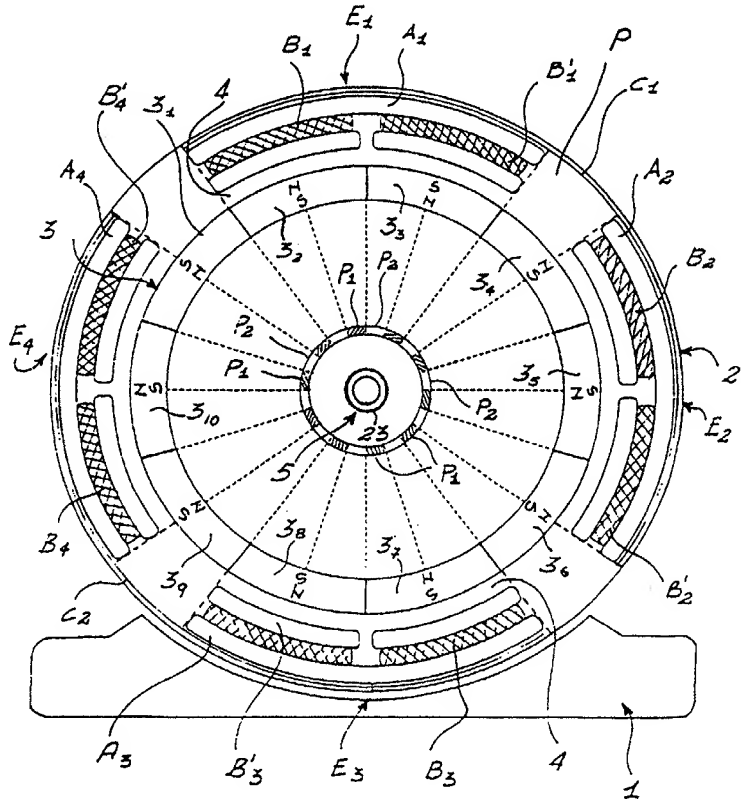
(81) Designated States: AU, BR, CA, CN, IN, JP, RU, US, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: PERMANENT MAGNET ELECTRIC MACHINE WITH ENERGY SAVING CONTROL

(57) Abstract

The present invention relates to a generator of energy as a dynamo–electric machine with employment of the parallel and superposed forces, of "artificial electromagnetic reaction" between the primary (2) and secondary (3) and of "natural ferromagnetic reaction" between the secondary and the primary. The primary comprises one or more pairs (C_1, C_2) of polar expansions (E_1, E_2; E_3, E_4), mechanically separated and electrically offset in phase from each other by a polar step (p) and each provided with a ferromagnetic core (A_1, A_2; A_3, A_4) and with at least an electromagnetic coil (B_1, B_1', B_2, B_2', B_3, B_3', B_4, B_4'), and the secondary (3) comprises a succession of alternate permanent magnets (3_1, 3_2,..., 3_{10}), and a related control system (5). Each polar step (p) spans half a permanent magnet of said alternate permanent magnets (3_1, 3_2,..., 3_{10}), equal to a quarter of a complete cycle (p_1 or p_2), the magnetic forces being balanced due to the characteristic paired disposition of the polar expansions active separately during the conductor steps (p_1) and its ferromagnetic cores active separately during the neutral steps in "natural" attraction (p_2) with the permanent magnets.



PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
11M210912WO3		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/IT99/00388	25/11/1999	28/01/1999
International Patent Classification (IPC) or national classification and IPC H02K37/14		
Applicant MICRONASA DI PATARCHI ALBERTO et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
27/07/2000	07.11.2000
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Drysdale, N Telephone No. +49 89 2399 2435

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IT99/00388

I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

1-11 as originally filed

Claims, No.:

1-16 as originally filed

Drawings, sheets:

1/5-5/5 as originally filed

2. The amendments have resulted in the cancellation of:

☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims 1-16
	No:	Claims
Inventive step (IS)	Yes:	Claims 1-16
	No:	Claims
Industrial applicability (IA)	Yes:	Claims 1-16
	No:	Claims

2. Citations and explanations

see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

V. Reasoned statement

2. Citations and explanations

1. Reference is made to the following documents:

   D1 = US 4 190 779 A
   D2 = US 4 864 199 A

   The document D2 was not cited in the international search report. A copy is appended hereto.

2. The claims on file do not satisfy the requirement of Art. 6 PCT because they are not clear - see Section VIII below. As far as they can be understood, however, the available documents illustrating the state of the art appear to provide no basis for an objection to the present claims on the grounds of lack of novelty or inventive step (Art. 33(2) & (3) PCT), while industrial applicability (Art. 33(4) PCT) is obvious for all claims.

3. The claimed invention appears to achieve a permanent magnet electrical machine with energy-saving control by providing a permanent magnet rotor and a stator with salient electromagnet poles, wherein essentially:
   (a) the stator poles are arranged in groups, with circumferentially adjacent groups offset angularly with respect to the rotor poles by a "polar step" (p) of half the span of a permanent magnet (claim 1) or a whole span (claim 5); and
   (b) the energising scheme of the stator poles leaves some poles de-energised so that the torque is provided by the attractive force between the rotor permanent magnets and the soft iron cores of the stator poles.

4. It is well known, particularly in the art of stepper motor control, to offset the stator poles by various amounts relative to the rotor poles - see, for example, document D1, Fig. 11. However, D2 is the only document known to the examiner which considers the effect of magnetic attraction between permanent magnet rotor poles (24-1) to (24-8) (Fig. 1) and the soft iron cores (32) of de-energised electromagnet poles (28-1) to (28-9) (see col. 8, lines 46-59). Even if a skilled person were to

consider combining the teaching of D1 and D2, the result would not be the subject-matter of present claims 1 and 5, which must therefore be considered as being novel and inventive (Art. 33(2) & (3) PCT).

The dependent claims define advantageous embodiments of the machine of claims 1 and 5. Their subject-matter is therefore also novel and inventive (Art. 33(2) & (3) PCT).

VII. Certain defects

1. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D1 and D2 is not mentioned in the description, nor are these documents identified therein.

VIII. Certain observations

1. The claims are very unclear and therefore do not satisfy the requirement of Art. 6 PCT. Before any entry into a subsequent regional phase the whole application, in particular the claims, requires revision in order that a skilled person may understand precisely what is included in the desired scope of protection and what is not. Non-standard terminology is used throughout the application, e.g. "polar expansions", "the input and output of the permanent magnets", "heteronomous", "complete (energy) cycle", in contravention of Rule 10.1(e) PCT (the preceding examples are not exhaustive).

2. Claim 5 is drafted as dependent on claim 1. However, as claim 5 specifies that the "polar expansions" are offset by a "double polar step", which is inconsistent with claim 1, claim 5 is, in fact, another independent claim.

3. It is unclear whether it is an essential feature of the claimed machine that the rotor permanent magnet poles should be **contiguous**, as illustrated in the figures, or whether adjacent poles can be separated along the rotor circumference. Associated with this point is the question of whether the "span" of a permanent magnet

refers to the angular extent of the pole or the pole pitch, i.e. the distance between corresponding points on adjacent poles. It is also unclear whether the separation of half of a permanent magnet span (claim 1) or a whole span (claim 5) is tied to a system with only **two** pairs of stator "polar expansions", as shown, or would also be valid for different numbers of pairs. The meaning of "opposite" in claim 10 is obscure. The expression "negative feedback" in the context of electromagnet excitation (claim 16) is obscure.

PATENT COOPERATIC TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Assistant Commissioner for Patents
United States Patent and Trademark Office
Box PCT
Washington, D.C.20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 07 September 2000 (07.09.00)	
International application No. PCT/IT99/00388	**Applicant's or agent's file reference** 11M210912WO3
International filing date (day/month/year) 25 November 1999 (25.11.99)	**Priority date** (day/month/year) 28 January 1999 (28.01.99)
Applicant PATARCHI, Alberto	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

27 July 2000 (27.07.00)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer Zakaria EL KHODARY
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : **H02K 37/14** — **A1**

(11) International Publication Number: **WO 00/45501**

(43) International Publication Date: 3 August 2000 (03.08.00)

(21) International Application Number: PCT/IT99/00388

(22) International Filing Date: 25 November 1999 (25.11.99)

(30) Priority Data:
RM99A000066 28 January 1999 (28.01.99) IT

(71) Applicant *(for all designated States except US)*: MICRONASA DI PATARCHI ALBERTO [IT/IT]; Viale della Marina, 3, I–00122 Ostia Lido (IT).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: PATARCHI, Alberto [IT/IT]; Viale della Marina, 3, I–00122 Ostia Lido (IT).

(74) Agent: BELLOMIA, Paolo; Bugnion S.p.A., Via Vittorio Emanuele Orlando, 83, I–00185 Roma (IT).

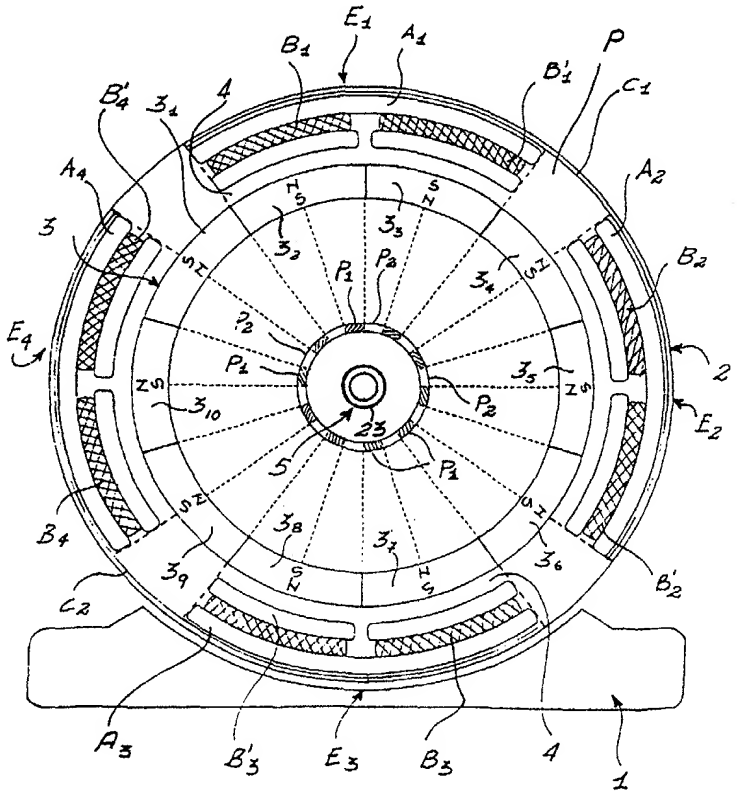
(81) Designated States: AU, BR, CA, CN, IN, JP, RU, US, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: PERMANENT MAGNET ELECTRIC MACHINE WITH ENERGY SAVING CONTROL

(57) Abstract

The present invention relates to a generator of energy as a dynamo–electric machine with employment of the parallel and superposed forces, of "artificial electromagnetic reaction" between the primary (2) and secondary (3) and of "natural ferromagnetic reaction" between the secondary and the primary. The primary comprises one or more pairs (C_1, C_2) of polar expansions (E_1, E_2; E_3, E_4), mechanically separated and electrically offset in phase from each other by a polar step (p) and each provided with a ferromagnetic core (A_1, A_2; A_3, A_4) and with at least an electromagnetic coil (B_1, B_1', B_2, B_2', B_3, B_3', B_4, B_4'), and the secondary (3) comprises a succession of alternate permanent magnets (3_1, 3_2,..., 3_{10}), and a related control system (5). Each polar step (p) spans half a permanent magnet of said alternate permanent magnets (3_1, 3_2,..., 3_{10}), equal to a quarter of a complete cycle (p_1 or p_2), the magnetic forces being balanced due to the characteristic paired disposition of the polar expansions active separately during the conductor steps (p_1) and its ferromagnetic cores active separately during the neutral steps in "natural" attraction (p_2) with the permanent magnets.



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Description

PERMANENT MAGNET ELECTRIC MACHINE WITH ENERGY SAVING CONTROL

Technical Field

The present invention relates to an energy generator as a dynamo-electric machine with separate employment of the interacting forces and their balancing with permanent magnets.

The term "dynamo-electric machine" designates any machine which converts mechanical energy into electrical energy and vice versa. The type of machine whereto the present invention refers is the one wherein a primary comprises a multiplicity of polar expansions and a secondary comprises a succession of heteronomous alternated permanent magnets.

Background Art

It is well known that both in motors and in generators of this kind, electromagnets act by attraction or repulsion over the entire pitch of the magnets in two semi-cycles, that is to say at full cycles from permanent magnet to permanent magnet, and hence in none of the known motors or generators is the active effect of the interaction of the magnets with the highly permeable ferromagnetic cores taken into account, nor is the equilibrium i.e. the balancing of the ferromagnetic forces which cancel out the permanent magnetic resistant torque to pass from one permanent magnet to the other.

Disclosure of Invention

Although in the considerations that follow reference shall be made, for the sake of convenience, mostly to motors, the same considerations apply for generators as well.

In particular, the invention constituting the subject of the invention is aimed at

determining at relative disposition between the pairs of electromagnets of the primary and the permanent magnets of the secondary which is able to harmonise the forces at play, whose magnetic nature is respectively permanent, ferromagnetic and electromagnetic.

Another aim of the present invention is to reach a high efficiency in the transformation of electrical into mechanical energy and vice versa thanks to an appropriate electrical power supply of the electromagnets of the primary in their interaction with the permanent magnets of the secondary.

Yet another aim of the present invention is to provide an electric motor which can be controlled by an appropriate control system according to the characteristics required in each particular case, with adequate sensors such as optical, magnetic, resistive, inductive or other types of transducers which, through electronic circuits with transistors, thyristors, or triac, drive the supply of power to the machine, as well as common brush collectors, able to provide current at alternating polar steps to the coils offset by a polar step, first one than the other in succession for four steps of complete cycle.

The invention, as it is characterised by the claims that follow, solves the problem of providing a dynamo-electric machine with the harmonisation of the interacting forces, of the type having a primary comprising one or more pairs of polar expansion positioned one at the centre of the permanent magnets and the others astride two permanent magnets, mutually distanced by a polar step and each provided with a ferromagnetic core and with at least one electromagnetic coil, and a secondary comprising a succession of alternate heteronomous permanent magnets, and a related control system, which from a general point of view, is characterised in that each polar step of electrical conduction spans half permanent magnet of said alternate heteronomous permanent magnets and in that said electrical conduction is driven at alternate phases: in the first step the coil or coils in negative feedback facing the centre of the permanent magnet, then in the second step the coil or coils in negative feedback which were astride the permanent magnets and which are in turn taken to

the centre, then the third step again the coil or coils in negative feedback of the first step but with opposite electrical polarity still in negative feedback, then the fourth step again the coil or coils in negative feedback of the second step with opposite electrical polarity still in negative feedback closing a complete electrical conduction cycle, the two phases are carried out for separate two fourths by a first coil of the balancing pair and for other separate two fourths by a second coil of the balancing pair offset by a polar step and always with electrical polarity suitable to obtain the negative feedback with the opposed permanent magnets and always at the output of each half alternate heteronomous permanent magnet. The invention lets the "natural "permanent magnetic force active in attraction of the alternate heteronomous permanent magnets with the high-permeability ferromagnetic cores be always unbalanced in attraction, first a ferromagnetic core than the other concurring to create a complete parallel and superposed dual cycle of "natural" mechanical energy which goes to the axis of the dynamo-electric machine together with the cycle of "artificial" electromagnetic energy transformed by negative feedback with the consequent addition of the two separate and parallel energies, obtaining a high efficiency of the machine of the invention.

Although in the present description the invention is described with reference to a rotatory dynamo-electric machine, it can also be applied to linear machines or annular linear machines and to devices for partial servo-controls.

Further features and advantages of the present invention shall become more readily apparent from the detailed description that follows, of preferred embodiments illustrated purely by way of non-limiting indication in the accompanying drawings.

Description of the Drawings

- Figure 1 schematically shows in cross section view an embodiment of a dynamo-electric machine according to the present invention;
- Figure 2 shows the basic components of the dynamo-electric machine of Figure 1 and a related diagram of the forces interacting between them;

- Figure 3 schematically shows a complete attraction and repulsion cycle between the basic components of the dynamo-electric machine of Figure 1;
- Figure 4 schematically shows a complete cycle of attraction and repulsion between pairs of electromagnets and magnets;
- Figure 5 shows a diagram of the electromagnetic energies at play in the cycle of Figure 4;
- Figure 6 shows a diagram of the ferromagnetic at play in the cycle of Figure 4;
- Figures 7 through 9 schematically show, in section view, respective different dispositions between primary electromagnets and secondary permanent magnets whereto the present invention can be applied.

Description of the Illustrative Embodiment

According to the present invention, Figure 1 schematically shows in cross section view an embodiment of an electric motor, taken for instance from an energy generator as dynamo-electric machine according to the present invention.

As shown in Figure 1, on a support base 1 is mounted a stator 2, the primary of the machine, coaxially to whose interior is a rotor 3, the secondary. In the stator 2 is provided one or more pair of polar expansions, two in the example shown, indicated as C_1 and C_2. The polar expansions E_1, E_2, E_3, E_4 and the pair C_1 with C_2 are mutually separated by a polar step (p), i.e. the distance measured on the air gap arc between the start of a permanent magnet and its centre (half magnet). Each polar expansion (E_1, E_2, E_3, E_4) is provided with a horseshoe shaped ferromagnetic core (A_1, A_2, A_3, A_4), and with electromagnetic coils (B_1, B_1', B_2, B_2', B_3, B_3', B_4, B_4'). In the secondary, the rotor 3 is provided with a succession of alternate heteronomous permanent magnets 3_1, 3_2, ..., 3_{10}, separated from the polar expansions E_1, E_2, E_3, E_4 by an air gap 4. Further provided is a system for controlling the motor, of a known kind, schematically illustrated in the brush collector 5, characterised by neutral polar steps (p_2) and conductor polar steps (p_1) for the alternating electrical switching of the coils (B_1, B_1', B_2, B_2') or (B_3, B_3', B_4, B_4'), with polarity inversion due to the negative

feedback with the heteronomous alternate permanent magnets on the output polar step of each half magnet.

In other words, the machine comprises one or more pairs C_1, C_2 of polar expansions, E_1 and E_3, E_2 and E_4, mechanically and electrically distanced by a polar step (p) equal to a fourth of a cycle and "half a permanent magnet" 3 whereof one expansion, E_1 and E_3, positioned opposing the full position of the alternated heteronomous permanent magnets 3_2 and 3_3, 3_7 and 3_8, and the other, E_2 and E_4, astride the permanent magnets, 3_4, 3_5 and 3_5, 3_6 3_9, 3_{10} and 3_{10} 3_1 obtaining as a result a balanced equilibrium of the ferromagnetic torque forces interacting between the high permeability cores, A_1 and A_2, A_3 and A_4, with the alternated heteronomous permanent magnets, 3_1, 3_2,..., 3_{10}, and an electrical offset between the electromagnetic coils of the pair B_1, B_1' and B_2, B_2', B_3, B_3' and B_4, B_4', for the contiguous closure of the alternate steps superposed in the two complete and separate cycles of positive and negative energy on two heteronomous permanent magnets of opposite polarity in four fourths of a cycle (12, 14, 13 and 15; 16, 18, 19 and 17), each electromagnetic coil of the pair or group of coils equally positioned in phase (B_1, B_1', B_3 and B_3'; B_2, B_2', B_4 and B_4') alternatively act for two separate fourths of a cycle with "artificial electromagnetic or mechanical energy" (12 and 13; 14 and 15) during the conductor steps (p_1) and for two separate fourths of a cycle with "natural ferromagnetic energy" (16 and 17; 18 and 19) during the neutral steps (p_2) electrically isolated, through the related control system 5, completing the two cycles of separate, consecutive, superposed and parallel "artificial" energy 12, 14, 13 and 15 plus the "natural" energy 16, 18, 19 and 17. When the dynamo-electric machine operates as a generator of mechanical energy, i.e. as a motor, each electromagnetic coil or group of coils (B_1, B_1', B_3 and B_3'; B_2, B_2', B_4 and B_4') equally positioned are powered with positive and negative electrical current to obtain the negative feedback from the centre of the permanent magnets for the polar step (p_1) until the end of the permanent magnets at alternating steps 12, 14, 13 and 15 and contiguous for a complete repulsion cycle on two magnets of opposite polarity and for two separate fourths each

(12 and 14; 13 and 15) whilst the "natural" cycle of permanent magnetic attraction is conducted by the ferromagnetic cores (A_1, A_3; A_2, A_4) in parallel and superimposed to the "artificial" cycle during the neutral polar steps (p_2) of the non-powered coils (16, 18, 19 and 17) also for two separate two fourths each (16 and 17; 18 and 19); vice versa when the dynamo-electric machine operates as a generator of electrical energy it is powered with mechanical energy aided by the complete cycle of "natural" magnetic attraction during the neutral steps (p_2).

The illustrated embodiment of a polar expansion is related to an ideal circuit with the closure of the electromagnetic flow in a pair of successive permanent magnets with opposite polarity.

Hereafter, the description shall show how a dynamo-electric machine thus realised presents a harmonisation of the interacting forces and, as a consequence, a high efficiency.

For the sake of simplicity hereafter the case shall be considered of polar expansions not interacting with pairs of permanent magnets but with one permanent magnet at a time.

In particular, in the case wherein the machine operates as a motor, in Figure 2 the indications A_1 and B_1 denote respectively a ferromagnetic core and an electromagnetic coil of a polar expansion E_1 of the primary, and the indication 3_1 denotes a permanent magnet of the secondary. For the sake of convenience, the relative motion of the polar expansion of A_1, B_1, with respect to the permanent magnet 3_1 is considered, as if the rotor were fixed.

The ferromagnetic core of A_1 has high permeability so that it is attracted towards the permanent magnet 3_1, by the "natural" ferromagnetic attraction when the coil B_1 is not energised. The polar expansion E_1 moves to E_1'. The corresponding energy is proportional to the surface area of the right triangle 6. The "artificial" electromagnetic repulsion when the coil B_1 is energised is proportional to the surface area of the triangle 7. The polar expansion E_1 moves to E_1''.

With reference to Figure 3, a complete attraction and repulsion with alternating

steps of a polar expansion E_1, with a pair of heteronomous permanent magnets 3_1 and 3_2 of opposite polarity, is shown schematically. The polar expansion E_1 moves to E_1' by "natural" magnetic attraction between said permanent magnet 3_1 and the ferromagnetic core A_1. The corresponding energy is proportional to the surface area of the rectangle 8. The "artificial" electromagnetic repulsion when the coil B_1 is energised with positive electrical power proportional to the surface area of the rectangle 9. The polar expansion E_1 moves to E_1". Hence, by "natural" magnetic attraction with the permanent magnet 3_2, the polar expansion E_1 moves to E_1' ". The corresponding energy due to "natural" permanent magnetic attraction is proportional to the surface area of the rectangle 10. Thus, the "artificial" electromagnetic repulsion when the coil B_1 is energised with negative electrical power, proportional to the surface area of the rectangle 11, takes the polar expansion E_1 to E_1"", ready in attraction for another cycle. With reference to Figture 4, the mechanical coupling (C) distancing the ferromagnetic cores A_1 and A_2 for the balance of the "natural" permanent magnetic attraction forces between a permanent magnet and the other (3_1, 3_2, 3_3, 3_4, ...,) said ferromagnetic cores (A_1 and A_2) are distanced by a magnetic step p equal to half a permanent magnet, as in the motor shown by way of example in Fig. 1, or half permanent magnet plus one as in the scheme of the aforementioned example of a complete cycle Fig. 4, or half a permanent magnet plus a plurality of whole permanent magnets equally distanced (½, 1½, 2½, ...). Thus the "natural" ferromagnetic attraction torque forces are balanced and cancel each other out; moreover, the phase offset (p) between the coils (B_1 and B_2) by half permanent magnet has the purpose of completing with continuity the two parallel separate and superposed energy cycles over all the four steps necessary for the "natural" permanent attraction energy and to the "artificial" electromagnetic repulsion energy. Also schematically shown is the attraction cycle between the ferromagnetic cores A_1 and A_2 and the complete repulsion cycle of a pair of polar expansions E_1 and E_2 with the respective alternated heteronomous permanent magnets (3_1, 3_2, 3_3, 3_4) for each polar expansion E_1 and E_2 and each ferromagnetic core A_1 and A_2 one can repeat what has

been stated with reference to Figure 3, stressing again that, thanks to the half-magnet polar step (p), a harmonisation is reached between the "natural" magnetic forces and "artificial" electromagnetic forces, which leads to an increase in efficiency with respect to the case wherein power supply to the coils is continuous in the positive and respectively in the negative semi-cycle. The positive and negative electrical power supply cycle for the two coils of E_1 and E_2 is instead that of Figure 5, detailed in 12, 13, 14 and 15 for four steps of a complete cycle. Figure 6 instead shows the action of the ferromagnetic attraction forces in the same cycle steps 16, 17, 18, 19.

Therefore, when the dynamo-electric machine operates as a motor, each electromagnetic coil is powered with positive and negative electrical current or vice versa only for two separate fourths of cycle during a complete attraction and repulsion cycle on two successive heteronomous magnets.

To summarise, the dynamo-electric machine according to the invention has in its primary at least a pair of polar expansions, whereof one positioned opposing the centre of a permanent magnet of a series of alternated heteronomous permanent magnets of the secondary, and the other expansion positioned opposing astride two of said permanent magnets. The pair of polar expansions has a function of balancing and completing the fractioned cycle of linear electrical power supply at contiguous segments as well as the "natural" fractioned cycle separately (the coils of the expansions work only in repulsion on the output of half the permanent magnets; the highly permeable ferromagnetic cores work only in attraction on the input of half the permanent magnets).

In other words, the power supply of the polar expansions at alternating steps occurs when the ferromagnetic core is at the centre of a permanent magnet in negative feedback until the end of the permanent magnet, whilst in natural ferromagnetic attraction from the start of the permanent magnet to its centre, first one then the other linearly uniting the fractioned force cycle. The energy developed in the electrical power supply cycle and the one developed in the natural permanent magnetic cycle are added in interacting forces at the axis of the machine. The altenated power direct

current power supply of the polar expansions and of at least one pair, first one and then the other expansion in negative feedback (repulsion) occurs at complete cycles and with continuous absorption and the "artificial" electrical energy is transformed into mechanical energy, whilst the attraction at alternating steps between the ferromagnetic cores of at least one pair and the permanent magnets at the input first one and then the other core, create a further "natural" mechanical energy superimposed and parallel, continuous and linear which is added at the axis with the transformed "artificial" energy. Vice versa, if the dynamo-electric machine of the present invention operates as a generator of mechanical energy the axis of the machine is powered with mechanical energy which is transformed into electrical current by each electro-magnetic coil for two separate fourths of cycle each during a complete cycle, the energy produced is drawn by means of the control system during the conductor steps, whilst the "natural energy" of the neutral steps active in attraction add their energy to the mechanical one provided to the axis, with the result of a dual transformed energy and with total power relating to the sum of each separate cycle; or with the separate and direct withdrawal from the equally positioned coils belonging to the two superimposed energy cycles, in this case their electrical energy can be rectified before rejoining at the output, or re-phased.

The harmonisation of the aforementioned interacting forces characterises the "energy generator" invention as a high efficiency dynamo-electric machine.

With reference to Figure 7, a schematic representation is provided of a first possible form of interaction of a polar expansion with closure of the magnetic flow and with a pair of heteronomous permanent magnets 3_1, 3_2 in opposite position with the ferromagnetic core (A_1'), as in the example of Figure 1, for rotatory and linear dynamo-electric machine, said polar expansion can be position both linear circular and longitudinally to the axis of the secondary with alternated heteronomous permanent magnets, in this case with double band.

With reference to Figure 8 the polar expansion E" has air gaps at both sides of a ferromagnetic core (A_1") in axial disposition with respect to the band of the alternated

heteronomous permanent magnets for the closure of the magnetic flow 20, as in the case of a so-called linear and linear annular motor.

With reference to Figure 9, the polar expansion E" ' for the closure of the magnetic flow has permanent magnets at both sides of the ferromagnetic core (A_1" ') with two bands of alternated heteronomous permanent magnets 21, 22 belonging to two axial rotors or two linear tracks. Moreover, without references, it should be noted that for the construction and disposition of the polar expansions, of the ferromagnetic cores, of the permanent magnets and of its air gaps the realisation can be effected as in common and known dynamo-electric machines, it is just necessary according to the invention to respect the binomial of separation of the interacting flows to be harmonised with the alternating "artificial" electrical power supply of the active steps and of the neutral steps (not powered), which allow to exploit the "natural" potential attraction energy between the ferromagnetic cores and the permanent magnets always unbalanced in magnetic attraction step after step, main and necessary characteristic of the subject invention.

Purely by way of experimental, demonstrative, theoretical and practical example, the invention can be realised with two dynamo-electric machines with collector, appropriately and simply modified for the exploitation of the technique for separating the interacting forces constituting the subject of the invention: the two collectors are modified, each electrical polar step is divided into two steps, a neutral one and a conductor one, the axes of the two machines are fixed mechanically in series, forming a common mechanical axis, taking into account that it is necessary to offset by a polar step a collector of a machine with respect to the other one of the other machine, so that for instance in the case of a motor the electrical power supply powers at alternating polar steps first one machine and then the other, transforming the electrical energy from "artificial" repulsive electromagnetic force into mechanical energy, whilst the natural magnetic potential energy of the neutral polar steps in ferromagnetic attraction creates an additional "natural" mechanical energy parallel and superimposed with a resultant at the axis given by the sum of the energies at play,

separated and mutually harmonised: "artificial" plus "natural".

The invention thus conceived can be subject to numerous modifications and variations, without thereby departing from the scope of the inventive concept.

Claims

1. Energy generator as dynamo-electric machine with separate and harmonised employment of the positive and negative interacting forces at the input and output of the permanent magnets, characterised by a primary (2) comprising one or more pairs (C_1, C_2) of polar expansions (E_1, E_2; E_3, E_4), mechanically separated and electrically offset from each other by a polar step (p) and each provided with a ferromagnetic core (A_1, A_2, A_3, A_4) and with at least an electromagnetic coil (B_1, B_1', B_2, B_2'; B_3, B_3', B_4, B_4') and by a secondary (3) comprising a succession of alternated heteronomous permanent magnets (3_1, 3_2, ..., 3_{10}), and by a related control system (5), wherein each polar step (p) spans half a permanent magnet of said alternated heteronomous permanent magnets (3_1, 3_2, ..., 3_{10}), equal to a fourth of a complete cycle (p_1 or p_2) the magnetic forces being balanced by those of the permanent magnets for the characteristic paired disposition of the polar expansions active separately during the conductor steps (p_1) and its ferromagnetic cores active separately during the neutral steps in "natural" attraction (p_2), whose equilibrium disposition is obtained with the phase offset of the expansion pair with its ferromagnetic cores, one positioned at the centre of the permanent magnets and the other one distanced by a polar step (p) between two permanent magnets, thereby zeroing the competing forces, with a continuity, at alternating and superimposed steps, of "natural ferromagnetic" plus "artificial electromagnetic" energy in two complete superimposed energy cycles.

2. Energy generator as dynamo-electric machine according to claim 1, characterised in that the two separate energy cycles are divided into four fourths each acting on two permanent magnets of opposite polarity (3_1, 3_3, 3_5, 3_7, 3_9 with 3_2, 3_4, 3_6, 3_8, 3_{10}), in the first "natural energy" cycle at the input of the permanent magnets the two ferromagnetic cores of the pair (C_1, C_2) work first one then the other (A_1, A_3; A_2, A_4) during the alternating neutral steps (p_2) for two separate cycle fourths each in a complete cycle (16, 17; 18, 19) and in the second superimposed cycle of "artificial

energy" at the output of the permanent magnets, the polar expansions (E_1, E_2; E_3, E_4) of the pair (C_1, C_2) with its coils (B_1, B_1', B_3, B_3'; B_2, B_2', B_4, B_4') also work first one and then the other during the alternating conductor steps (p_1) for two separate cycle fourths each in a complete cycle (12, 13; 14, 15), all by means of the control system (5) that switches the neutral steps (p_2) and the conductor steps (p_1) alternatively on one (B_1, B_1', B_3, B_3') or the other coil (B_2, B_2', B_4, B_4') at the output of the permanent magnets.

3. Energy generator as dynamo-electric machine according to claim 1, characterised in that, when it operates as a motor, each electromagnetic coil (B_1, B_1', B_3, B_3'; B_2, B_2', B_4, B_4') is powered with positive and negative electrical current (12, 13; 14, 15) only for two separate cycle fourths during a complete repulsion cycle on two successive heteronomous permanent magnets during the conductor steps (p_1), switched by the control system (5), the electromagnetic energy is transformed into mechanical energy and goes to the axis (23) in parallel to the second superimposed cycle of "natural energy" (16, 17; 18, 19) produced by the ferromagnetic cores (A_1, A_3; A_2, A_4) at the input to the successive heteronomous permanent magnets during the neutral steps (p_2) also transformed in mechanical energy, with the addition of the two energies (12, 14, 13, 15) + (16, 18, 19, 17) and with continuous and linear absorption.

4. Energy generator as dynamo-electric machine according to claim 1, characterised in that, when it operates as a generator of electrical energy, the axis (23) of the machine is powered with mechanical energy which is transformed into electrical current by each electromagnetic coil (B_1, B_1', B_3, B_3'; B_2, B_2', B_4, B_4') for two separate cycle fourths each (12, 13; 14, 15) during a complete cycle (12, 13, 14, 15), the energy produced is drawn through the control system (5) during the conductor steps (p_1) whilst the "natural energy" of the neutral steps (p_2) active in attraction add their energy (16, 18, 19, 17) to the mechanical energy supplied to the axis (23) with

the result of a dual transformed energy (12, 14, 13, 15) + (12, 14, 13, 15) and with total power relating to the sum of each separate cycle.

5. Energy generator as dynamo-electric machine according to each of the previous claims, characterised in that the polar expansions (E_1 ...) of the primary (2) with the coils (B_1 ...) and the ferromagnetic cores (A_1 ...) are mechanically distanced from each other by a double polar step ($p_1 + p_2$) equal to an entire permanent magnet and all opposing the centre of the alternated heteronomous permanent magnets (3_1, 3_2, ...) of the secondary (3), whilst the working step (p) is always of a fourth of a cycle, equal to half a permanent magnet, the energy at play in the two separate cycles is not superimposed but dovetailed and in cyclical successions, for two separate cycle fourths (8, 10) between the "natural ferromagnetic energy" (E_1', E_1'' ') and for two other separate cycle fourths (9, 11) with the "electromagnetic energy" (E_1'', E_1'''') for a complete cycle, alternate by contiguous of four fourths (8, 9, 10, 11), all controlled by a system that electrically connects the coils at alternating steps (p), a conductor step (p_1) and a neutral step (p_2) in cyclical sequence.

6. Energy generator as dynamo-electric machine according to each of the previous claims, characterised in that the polar expansions (E_1, E_2; E_3, E_4) of the primary (2) and the alternated heteronomous permanent magnets (3_1, 3_2, ..., 3_{10}) of the secondary (3) can be positioned indifferently opposite in the stator (2) and rotor (3) and vice versa.

7. Energy generator as dynamo-electric machine according to each of the previous claims, characterised in that the polar expansions (E_1, E_2, E_3 and E_4) of the primary (2) are positioned longitudinally to the axis of motion (23) with the secondary (3) and opposite to the North South permanent magnets (3_1, 3_2) also positioned longitudinally and in heteronomous alternated succession (3_1 and 3_2, 3_3 and 3_4, 3_5 and 3_6, ...).

8. Energy generator as dynamo-electric machine according to each of the previous claims, characterised in that the control system (5) comprises a collector with related brushes which electrically connect at alternating conductor (p_1) and neutral (p_2) polar steps (p) the coils (B_1, B_1', B_3, B_3'; B_2, B_2', B_4, B_4') of the polar expansions (E_1, E_3; E_2, E_4) said polar steps (p) switch with a frequency of a fourth of a cycle.

9. Energy generator as dynamo-electric machine according to claims 1, 2, 3, 4, 5 and 6 characterised in that the control system (5) comprises a decoder of the alternating polar steps (p) corresponding to the conductor steps (p_1) and neutral steps (p_2), by optical, magnetic, resistive, inductive or other measuring systems which drive an electronic control system with transistors, thyristors, triac or other means for the alternated electrical conduction switching of the coils (B_1, B_1', B_3, B_3'; B_2, B_2', B_4, B_4') relating to the polar expansions (E_1, E_3; E_2, E_4) said polar steps (p) switch with a frequency of a fourth of a cycle.

10. Energy generator as dynamo-electric machine according to claims 1, 2, 3, 4, 5, 6 and 7 characterised in that said polar expansion (E') cores (A') and said permanent magnets (3_1, 3_2) are opposite.

11. Energy generator as dynamo-electric machine according to claims 1, 2, 3, 4, 5, 6 and 7 characterised in that said polar expansion (E") cores (A_1") and said permanent magnets (20) are in an axial relationship.

12. Energy generator as dynamo-electric machine according to claims 1, 2, 3, 4, 5, 6 and 7 characterised in that said polar expansion (E' ") cores (A_1' ") are axially opposite pairs (21, 22) of said permanent magnets positioned laterally thereto.

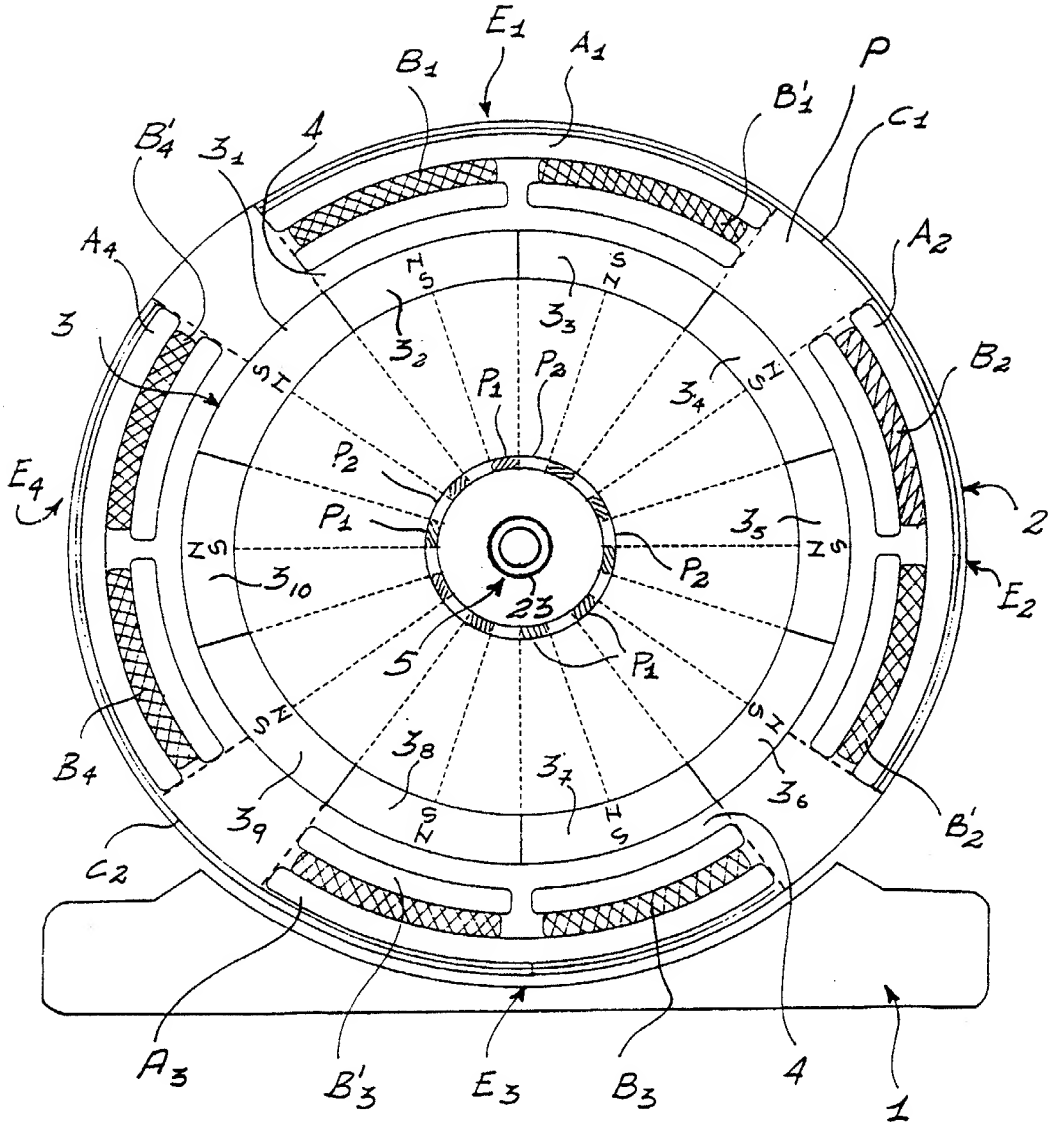
13. Energy generator as dynamo-electric machine according to each of the previous claims characterised in that the disposition of the polar expansions (E_1, E_2, E_3 and E_4)

of the primary (2), of the alternated heteronomous permanent magnets (3_1, 3_2 ...) of the secondary (3) and of the control system (5) is indifferently rotatory, linear, linear annular, as well as with partial sectors for servo-controls destined to specific uses.

14. Energy generator as dynamo-electric machine according to each of the previous claims characterised in that the invention is realised by coupling (C_1, C_2) two traditional dynamo-electric machines (M_1, M_2), mechanically and electrically offset by the rotation of a fourth of a cycle equal to one polar step (p) of one (M_1) with respect to the other (M_2) and mechanically fastened in line in a common axis (23) and which works through the control system (5) electrically switching first a dynamo-electric machine (M_1) then the other (M_2) for two separate fourths each (12, 13; 14, 15) in a complete cycle of four fourths of electromagnetic energy (12, 14, 13 and 15) during the conductor steps (p_1) and four superimposed fourths of natural energy (16, 18, 19, 17) relating to the neutral polar steps (p_2).

15. Energy generator as dynamo-electric machine according to each of the previous claims characterised in that the invention is realised with a common traditional dynamo-electric machine wherein the switch of its expansions E_1, E_2, ...) is performed for instance with a traditional collector (5) having twice the number of polar steps (p), a conductor step (p_1) and a neutral step (p_2) equal to two separate cycle fourths each (8, 10 and 9, 11), functioning in cyclical sequence for a complete alternated by contiguous cycle of four fourths (8, 9, 10, 11).

16. Energy generator as dynamo-electric machine according to each of the previous claims characterised in that the permanent magnets (3_1, 3_2, 3_3, ... 3_{10}) which create the magnetic field are constituted by electromagnets excited electrically in negative feedback.


E1
A1
B1
P
B'1
C1
B'4
3
4
A2
A4
3
B2
E4
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E2
B4
B'2
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1
23
5
P1
P2
N
S
Z

FIG.1

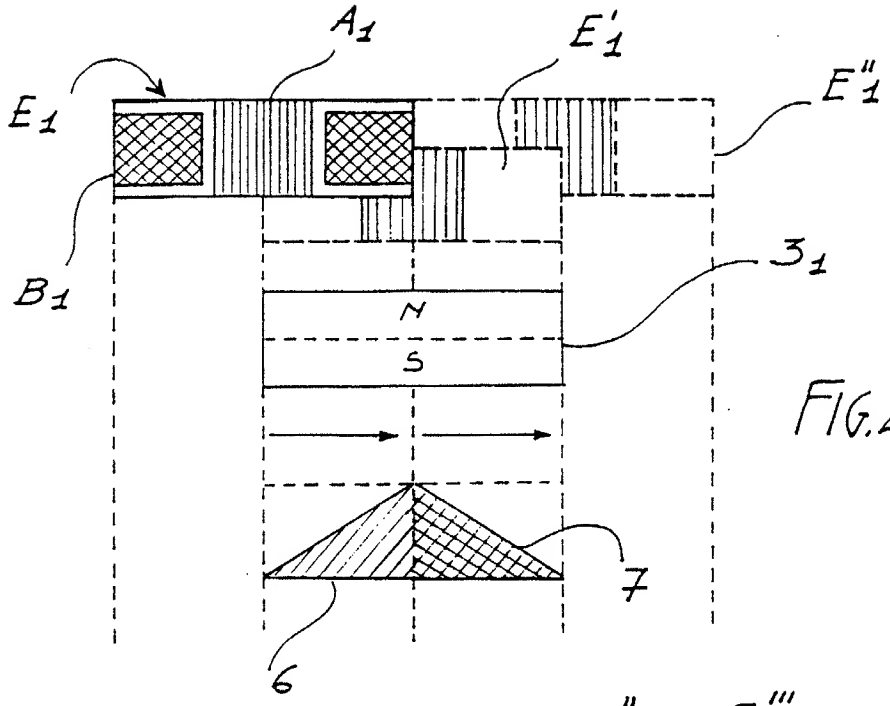


FIG.2

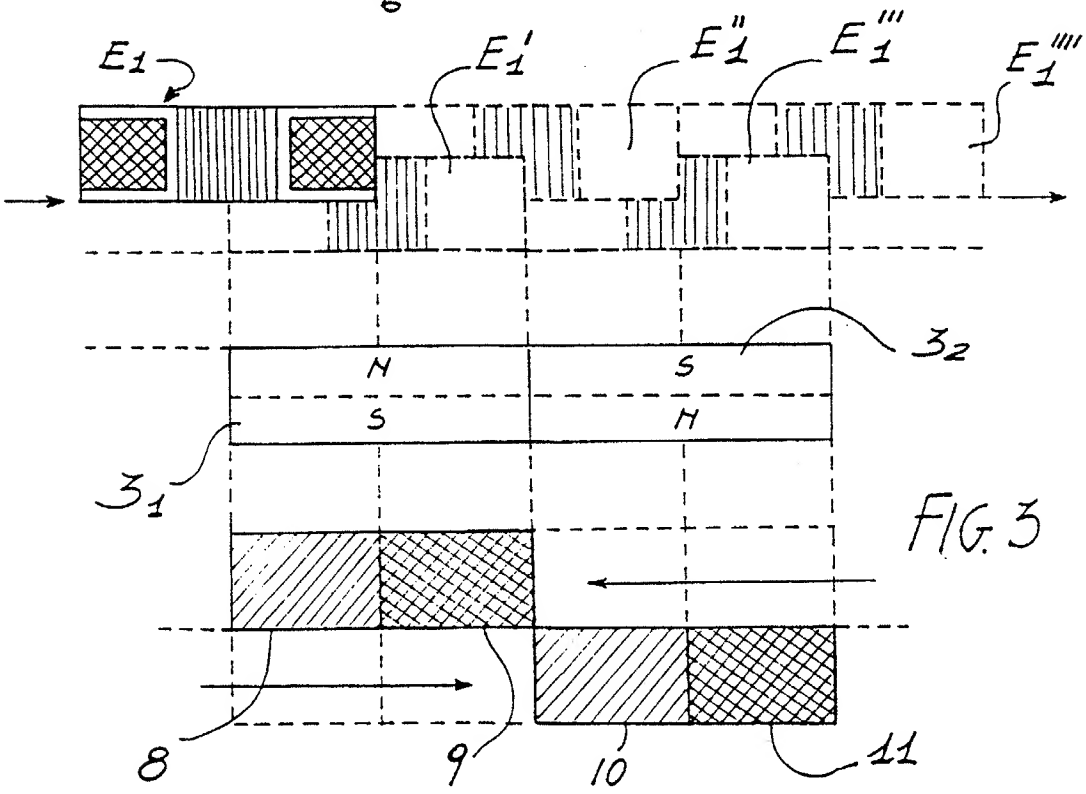
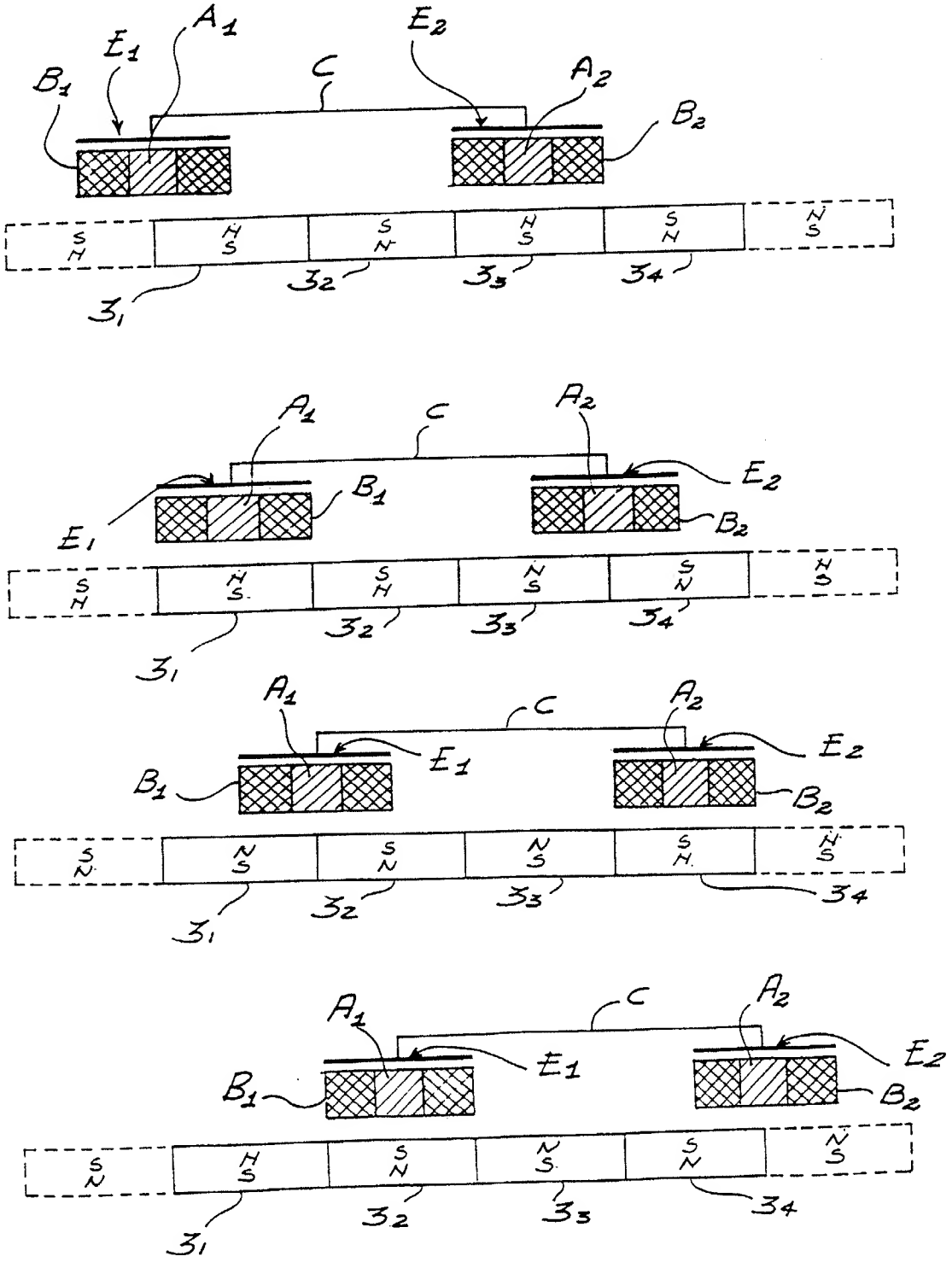


FIG.3

FIG. 4



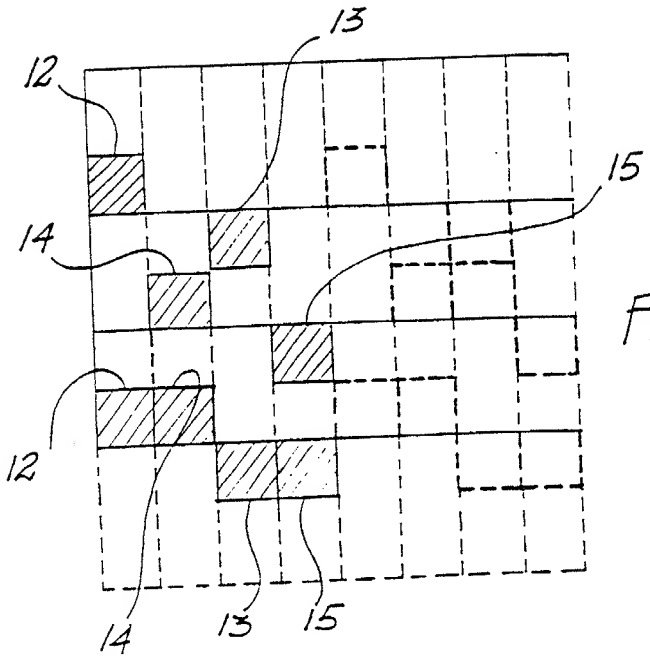


FIG. 5

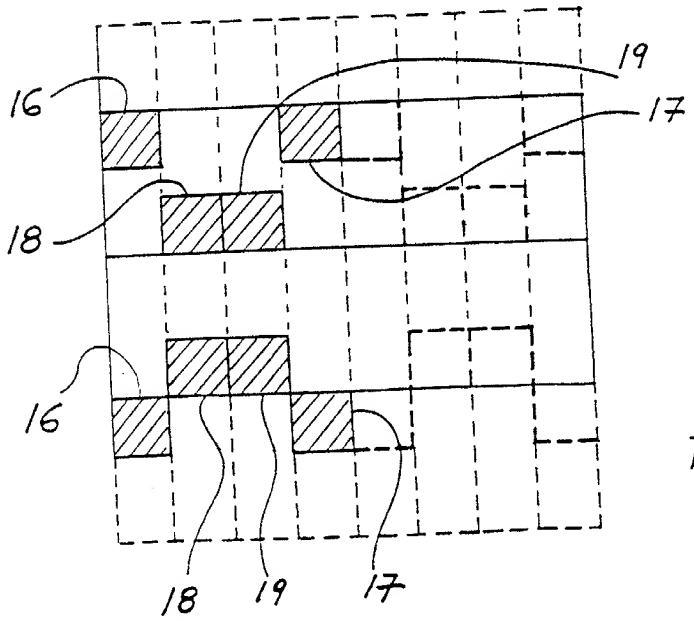


FIG. 6

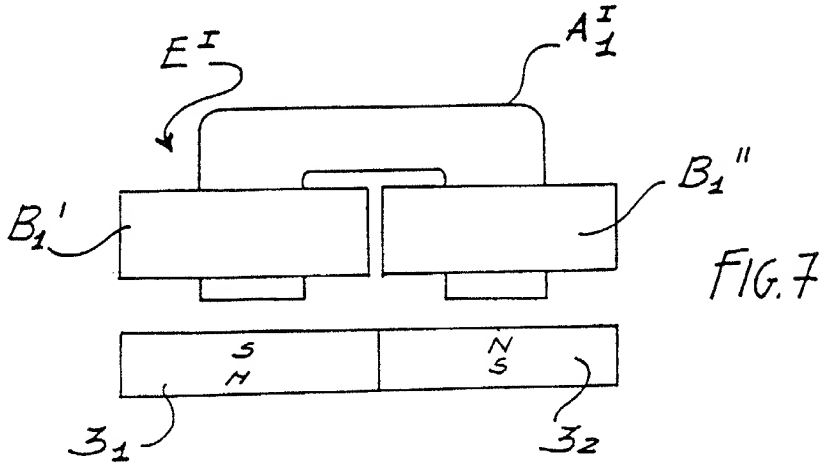


FIG. 7

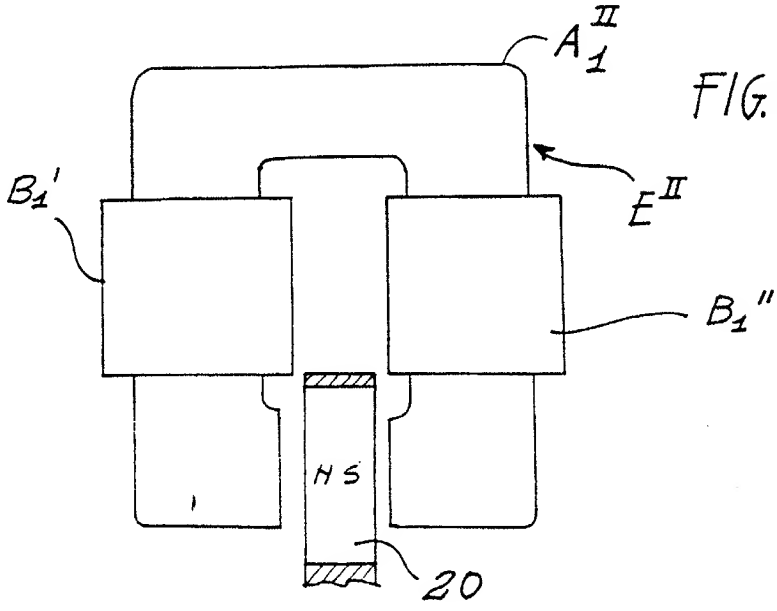
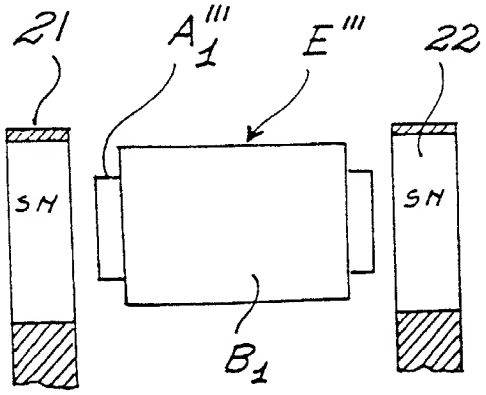


FIG. 8

FIG. 9



INTERNATIONAL SEARCH RE. ORT

Inter nal Application No
PCT/IT 99/00388

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H02K37/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H02K H02P

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 190 779 A (SCHAEFFER ERNEST) 26 February 1980 (1980-02-26) column 4, line 63 - line 68 column 8, line 63 - line 67 column 9, line 13 - line 20 figure 11	
A	WO 97 23943 A (SONCEBOZ S A ;PRUDHAM DANIEL (FR)) 3 July 1997 (1997-07-03) page 1, line 15 - line 31	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 March 2000	27/03/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Foussier, P

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INTERNATIONAL SEARCH R\ )RT

information on patent family members

Interr. ..al Application No
PCT/IT 99/00388

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4190779 A	26-02-1980	US 4315171 A	09-02-1982
WO 9723943 A	03-07-1997	FR 2742940 A	27-06-1997
		EP 0811269 A	10-12-1997
		JP 11501800 T	09-02-1999

PATENT COOPERATIC 'REATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
11M210912W03		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/IT 99/ 00388	25/11/1999	28/01/1998
Applicant		
MICRONASA DI PATARCHI ALBERTO et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   [ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

   b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

   [ ] contained in the international application in written form.

   [ ] filed together with the international application in computer readable form.

   [ ] furnished subsequently to this Authority in written form.

   [ ] furnished subsequently to this Authority in computer readble form.

   [ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   [ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

   [ ] the text is approved as submitted by the applicant.

   [X] the text has been established by this Authority to read as follows:

   PERMANENT MAGNET ELECTRIC MACHINE WITH ENERGY SAVING CONTROL

5. With regard to the **abstract**,

   [ ] the text is approved as submitted by the applicant.

   [X] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 1

   [ ] as suggested by the applicant.

   [X] because the applicant failed to suggest a figure.

   [ ] because this figure better characterizes the invention.

   [ ] None of the figures.

INTER. ,IONAL SEARCH REPORT

International application No.
PCT/IT 99/00388

Box III TEXT OF THE ABSTRACT (Continuation of item 5 of the first sheet)

The present invention relates to a generator of energy as a dynamo-electric machine with employment of the parallel and superposed forces, of "artificial electromagnetic reaction" between the primary (2) and secondary (3)and of "natural ferromagnetic reaction" between the secondary and the primary. The primary comprises one or more pairs (C_1, C_2) of polar expansions (E_1, E_2; E_3, E_4), mechanically separated and electrically offset in phase from each other by a polar step (p) and each provided with a ferromagnetic core (A_1, A_2; A_3, A_4) and with at least an electromagnetic coil (B_1, B_1', B_2, B_2'; B_3, B_3', B_4, B_4'), and the secondary (3) comprises a succession of alternate permanent magnets (3_1, 3_2, ..., 3_{10}), and a related control system (5). Each polar step (p) spans half a permanent magnet of said alternate permanent magnets (3_1, 3_2, ...,3_{10}), equal to a quarter of a complete cycle (p_1 or p_2), the magnetic forces being balanced due to the characteristic paired disposition of the polar expansions active separately during the conductor steps (p_1) and its ferromagnetic cores active separately during the neutral steps in "natural" attraction (p_2) with the permanent magnets.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IT 99/00388

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H02K37/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H02K H02P

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 190 779 A (SCHAEFFER ERNEST) 26 February 1980 (1980-02-26) column 4, line 63 - line 68 column 8, line 63 - line 67 column 9, line 13 - line 20 figure 11	
A	WO 97 23943 A (SONCEBOZ S A ;PRUDHAM DANIEL (FR)) 3 July 1997 (1997-07-03) page 1, line 15 - line 31	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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Date of the actual completion of the international search	Date of mailing of the international search report
8 March 2000	27/03/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Foussier, P

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
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		EP 0811269 A	10-12-1997
		JP 11501800 T	09-02-1999

PCT ORGANISATION MONDIALE DE LA PROPRIETE INTELLECTUELLE
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DEMANDE INTERNATIONALE PUBLIEE EN VERTU DU TRAITE DE COOPERATION EN MATIERE DE BREVETS (PCT)

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H02K 37/14	**A1**	**WO 97/23943**
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95/15438 22 décembre 1995 (22.12.95) FR

(71) Déposant *(pour tous les Etats désignés sauf US)*: SONCEBOZ S.A. [CH/CH]; CH-2605 Sonceboz (CH).

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(74) Mandataire: BREESE-MAJEROWICZ; 3, avenue de l'Opéra, F-75001 Paris (FR).

(81) Etats désignés: JP, KR, US, brevet européen (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

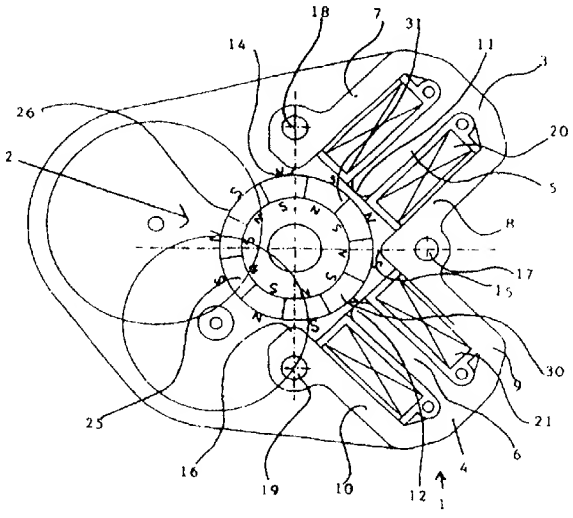
Publiée
Avec rapport de recherche internationale.

(54) Title: TWO-PHASE MOTOR, PARTICULARLY A TIME PIECE MOTOR OR A MOTOR FOR DRIVING THE HAND OF A DISPLAY

(54) Titre: MOTEUR DIPHASE, NOTAMMENT UN MOTEUR D'HORLOGERIE OU UN MOTEUR POUR L'ENTRAINEMENT D'UNE AIGUILLE D'UN AFFICHEUR

(57) Abstract

The present invention relates to a two-phase motor formed by a stator part (1) excited by electric coils and a magnetised rotor (2). The rotor (2) has N pairs of poles which are radially magnetised in alternate directions, N being equal to 3 or 5. The stator part (1) has at least two W-shaped circuits (3, 4) comprising each an electric coil (20, 21) surrounding the central leg (5, 6). The "W" circuits (3, 4) are so arranged that when one of the central legs faces a magnetic transition, the other central leg faces a magnetic pole. The polar opening outs of the legs of a "W" circuit are angularly spaced by $\pi/4$. The polar opening outs of the central legs of the two "W" circuits (3, 4) belonging to different phases are angularly spaced apart by an angle which is substantially equal to $\pi/2 \pm k.\pi/N$, where N is the number of pairs of magnetic poles, that is 3 or 5, and k is equal to 0, 1, or 2.



(57) Abrégé

La présente invention concerne un moteur diphasé formé par une partie statorique (1) excitée par des bobines électriques et par un rotor (2) aimanté. Le rotor (2) présente N paires de pôles aimantés radialement en sens alternés, N étant égale à 3 ou à 5. La partie statorique (1) présente au moins deux circuits en forme de "W" (3, 4) comportant chacun une bobine électrique (20, 21) entourant la jambe centrale (5, 6). Les circuits en "W" (3, 4) sont disposés de façon à ce que lorsque l'une des jambes centrales se trouve en face d'une transition magnétique, l'autre jambe centrale se trouve en face d'un pôle magnétique. Les épanouissements polaires des jambes d'un circuit en "W" sont espacées angulairement de $\pi/4$. Les épanouissements polaires des jambes centrales de deux circuits en "W" (3, 4) appartenant à des phases différentes sont écartées angulairement d'un angle sensiblement égal à $\pi/2 \pm k.\pi/N$, où N est le nombre de paires de pôles magnétiques, soit 3 ou 5 et k est égal à 0, 1, ou 2.

UNIQUEMENT A TITRE D'INFORMATION

Codes utilisés pour identifier les Etats parties au PCT, sur les pages de couverture des brochures publiant des demandes internationales en vertu du PCT.

AT	Arménie	**GB**	Royaume-Uni	**MW**	Malawi
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MOTEUR DIPHASÉ, NOTAMMENT UN MOTEUR D'HORLOGERIE OU UN MOTEUR POUR L'ENTRAÎNEMENT D'UNE AIGUILLE D'UN AFFICHEUR.

La présente invention concerne un moteur électrique diphasé, notamment un moteur d'horlogerie ou un moteur pour l'entraînement d'une aiguille d'un afficheur.

De tels moteurs sont par exemple décrits dans le brevet européen EP587685 de la demanderesse. Le but de l'invention est d'améliorer de tels moteurs de façon à augmenter le couple et à éliminer la pièce de fermeture de flux sans perdre l'avantage de la simplicité de la fabrication et les possibilités d'intégration des mécanismes associés tels les réducteurs.

A cet effet, l'invention concerne un moteur diphasé formé par une partie statorique excitée par des bobines électriques et par un rotor aimanté présentant N paires de pôles aimantés radialement en sens alternés, N étant égal à 3 ou à 5. La partie statorique présente au moins deux circuits en forme de W comportant chacun une bobine électrique entourant la jambe centrale. Les circuits en W sont disposés de façon à ce que lorsque l'une des jambes centrales se trouve en face d'une transition magnétique, l'autre jambe centrale se trouve en face d'un pôle magnétique. Les épanouissements polaires des jambes d'un circuit en W étant espacées angulairement de $\pi/4$ et les épanouissements polaires des jambes centrales de deux circuits en W appartenant à des phases différentes étant écartées angulairement d'un angle sensiblement égal à $\pi/2 \pm k.\pi/N$, où N est le nombre de paires de pôles magnétiques, soit 3 ou 5 et k est égal à 0, 1, ou 2.

Un tel moteur répond aux objectifs de l'invention grâce à un nombre accru de dents actives (6 au lieu de 4) et grâce à une réduction du trajet des lignes de champ dans l'air. La forme du circuit statorique en "W"

assure la fermeture des lignes de champ entre le pôle central qui reçoit la bobine et les deux pôles adjacents.

Avantageusement, les deux circuits en "W" présentent une jambe commune. Le stator peut ainsi être réalisé sous forme d'une seule pièce, ce qui élimine tout problème de positionnement angulaire que l'on rencontre avec des stators formés de plusieurs pièces fixées sur un support.

Dans un mode de réalisation préférée, l'invention concerne un moteur de faible coût d'assemblage et de très faible épaisseur.

Selon une première variante, les jambes extérieures des deux circuits en "W" sont reliés par un pontet en forme d'arc de cercle, le pontet présentant avantageusement des dents statoriques écartées de $\pi/4$ degrés. Cette variante permet de réaliser un moteur avec un nombre réduit de composant, à savoir un rotor, un stator formé par une seule pièce supportant deux bobines électriques seulement.

Les moteurs pas-à-pas selon l'état de la technique présentent par ailleurs un déplacement saccadé, dû au fait qu'un pôle aimanté du rotor trouve une position d'équilibre privilégié lorsqu'il est placé en regard d'une dent statorique, ou lorsqu'une transition entre deux pôles magnétiques se trouve en regard d'une dent statorique. Le couple de détente constitue de ce fait une fonction périodique de la position angulaire dont la fréquence dépend du nombre de pôles magnétique et du nombre de pôles statoriques. On a cherché dans l'état de la technique à "lisser" cette fonction en augmentant le nombre de pôles. Cela implique toutefois une plus grande complexité mécanique et un coût de fabrication et d'assemblage élevé.

Un deuxième but de la présente invention est de remédier à cet inconvénient en proposant une construction offrant, avec un nombre de pôles magnétiques et statorique raisonnable, une limitation sensible du couple de détente.

A cet effet, l'invention concerne un mode de réalisation préféré mettant en oeuvre quatre circuits en "W" dont les jambes adjacentes sont communes et forment ainsi un stator à 8 pôles. Les jambes centrales des circuits en "W" diamétralement opposés portent des bobines de la même phase.

Cette structure permet de réduire considérablement le couple de détente par annulation des harmoniques 2 et 4 de la fonction (couple de détente, position angulaire). Le moteur selon l'invention présente ainsi un déplacement non saccadé malgré le nombre réduit de pôles magnétiques ou statoriques.

Avantageusement, le stator est constitué par une pièce unique découpée pour présenter deux paires de circuits en "W" diamétralement opposés dont les extrémités polaires sont équidistantes angulairement. Avantageusement, les jambes recevant les bobines électriques s'étendent dans une partie centrale évidée dont les dimensions permettent l'introduction d'une bobine électrique dans le plan des jambes et la mise en place autour de la jambe correspondante par translation.

Les bobines peuvent être ainsi fabriquées séparément selon des procédés plus économiques que le bobinage autour d'une partie statorique complexes, et être ensuite enfilées sur les jambes correspondantes.

Le stator peut être fabriqué selon des procédés simples et peut coûteux. Le fait qu'il soit formé par une seule pièce découpée évite les problèmes de précision de l'assemblage et de dérèglement.

De préférence, les jambes portant les bobines électriques s'étendent radialement. Selon un mode de réalisation particulier, le stator est constitué par un empilement de tôles fines. Ce mode de réalisation permet d'utiliser des techniques d'usinage peu coûteuses pour la découpe du stator, et d'améliorer les performances magnétiques du stator.

De préférence, l'extrémité frontale de l'épanouissement polaire est située dans le plan de la face frontale intérieur de la bobine.

Selon une variante de réalisation particulière, le rotor est formé par un aimant aimanté suivant une direction perpendiculaire au plan du stator et placés entre deux disques crantés présentant des dents décalées.

Selon une variante particulière de réalisation, le moteur diphasé présente une pièce auxiliaire de fermeture de flux, avantageusement une pièce de fermeture du flux magnétique en un matériau doux coaxial avec le rotor.

Selon un premier mode de réalisation, la pièce de fermeture du flux magnétique est une pièce cylindrique en forme de bague.Cette bague peut être fixe par rapport au rotor, ou solidaire de l'aimant.

Selon un deuxième mode de réalisation, la pièce de fermeture du flux magnétique est une pièce cylindrique en forme de bague présentant des cannelures formant des dents placées en regard des dents statoriques.

L'invention sera mieux comprise à la lecture de la description qui suit, faisant référence aux dessins annexés où :

- les figures 1 et 2 représentent des vues respectivement de dessus et en coupe transversale d'une première variante d'un moteur selon l'invention ;
- la figure 3 représente une vue de dessus d'une deuxième variante du moteur selon l'invention ;
- la figure 4 représente une vue de dessus d'une troisième variante du moteur selon l'invention ;
- la figure 5 représente une vue de dessus d'une quatrième variante du moteur selon l'invention ;
- la figure 6 représente une vue en coupe transversale d'un rotor pour le moteur selon l'invention ;
- la figure 7 représente une vue de dessus dudit rotor ;

- la figure 8 représente une vue en coupe transversale d'une autre variante de rotor.

Les figures 1 et 2 représentent des vues respectivement de dessus et en coupe transversale d'un moteur selon l'invention. Le moteur comporte un stator (1) est un rotor (2).

Le stator (1) est réalisé par découpage dans une feuille métallique d'une épaisseur de 2 millimètres, ou par empilement de plusieurs feuilles métalliques en un matériau magnétiquement doux. Le stator présente deux circuits en "W" (3, 4) présentant chacun une jambe médiane (5, 6) et deux jambes latérales (7, 8 et 9, 10). Les jambes médianes (5, 6) se terminent chacune par un épanouissement polaire respectivement (11, 12). Les jambes latérales présentent également des épanouissements polaires (14 à 16), les deux jambes (8, 9) appartenant respectivement au premier circuit en "W" (3) et au second circuit en "W" (4) présentant dans l'exemple de réalisation décrit un épanouissement polaire commun.

Le stator (1) présente par ailleurs des trous (17, 18, 19) pour le passage d'organe de fixation sur un support, par exemple de vis ou des rivets.

Les jambes médianes (5, 6) reçoivent des bobines électriques respectivement (20, 21). Ces deux jambes (5, 6) sont orientées radialement.

Le rotor (2) présente 5 paires de pôles magnétiques. Il est formé par une pièce cylindrique (25) aimantée radialement pour présenter alternativement, à la surface extérieure (26), des pôles SUD et des pôles NORD. La partie aimantée peut être formée par l'association d'aimants minces en forme de tuiles collées sur un noyau cylindrique ou encore par l'aimantation de secteurs tubulaires.

Une autre solution encore consiste à aimanter en surface une pièce cylindrique selon des festons de façon à ce que deux pôles opposés soient formés par des éléments de

surface périphérique adjacents, reliés par une zone en arc de cercle pénétrant à l'intérieur de l'élément cylindrique.

Le rotor (2) est supporté de manière connue par des pivots (26, 27) visibles sur la figure 2.

Les jambes médianes (5, 6) des deux phases opposées supportant les bobines électriques (20, 21) sont orientées de manière à ce que, lorsqu'un pôle magnétique (30) est en regard de l'un des épanouissements polaires (12), l'autre épanouissement polaire (11) est en regard d'une transition (31).

Le rotor (2) présente une bague crantée (32) propre à entraîner un train d'engrenage (33 à 35). Ce train d'engrenage transmet le mouvement rotatif à un arbre de sortie (36).

Le stator (1) est logé dans l'exemple décrit dans un boîtier formé de deux coques (37, 38) complémentaires assurant par ailleurs le maintien des axes du train d'engrenage (32 à 35).

La figure 3 représente une variante de réalisation différente de celle précédemment décrit par le fait que les épanouissements polaires (14, 16) formant les extrémités des jambes extérieures (7, 10) des deux circuits sont réunies par un pontet (40) présentant des dents polaires (41 à 43). L'ensemble formé par les circuits en "W" (3, 4) et par le pontet (40) est découpé dans une seule pièce en un matériau magnétiquement doux, ou dans une pluralité de feuilles qui forment un empilement.

La partie centrale (45) du stator (1) est évidée. L'introduction des bobines électriques (20, 21) s'effectue par un premier déplacement selon une direction perpendiculaire au plan du stator correspondant au plan de la figure 3, puis par déplacement par translation radiale pour faire glisser la bobine autour de l'une des jambes médianes (5, 6). Cette opération est bien sur réalisée avant que le rotor (2) ne soit mis en place. La bobine peut être formée sur un noyau (46, 47) dont la section est

complémentaire de celle des jambes (5, 6) et présentant une face frontale (48, 49) venant affleurer l'extrémité de l'épanouissement polaire (11, 12) de la jambe (5, 6) correspondante.

La figure 4 représente une vue de dessus d'une troisième variante de réalisation différent des précédentes variantes par le fait que les circuits en "W" (3, 4) sont séparés. Ils sont positionnés de façon à ce que, lorsque l'épanouissement polaire (11) de la jambe centrale (5) de l'un des circuits en "W" (3) se trouve en face d'une transition magnétique (31), l'épanouissement polaire (12) de la jambe centrale (6) de l'autre circuit en "W" (4) se trouve en face d'un pôle magnétique (50).

La figure 5 représente une vue de dessus d'une quatrième variante de réalisation différent des précédentes variantes par le fait qu'il comporte quatre circuits en "W" (51, 52, 53, 54). Deux circuits en "W" diamétralement opposés appartiennent à une même phase. Les jambes médianes (55, 56, 57, 58) supportent chacune une bobine électrique (59, 60, 61, 62). Deux jambes latérales consécutives (63, 64), (66, 67), (69, 70), (72, 73) représentent des épanouissements polaires respectivement (65, 68, 71, 74) communs. Les épanouissements polaires consécutifs (65, 68, 71, 74, 75 à 78) sont écartés angulairement de $\pi/4$.

Le stator présentant les quatre circuits en "W" (51 à 54) est découpé dans une pièce unique ou dans un empilement de pièces et définit un évidement central (80) dont les dimensions et la forme permet l'enfilement des bobines (59 à 62) sur les jambes médianes (55 à 58).

Les figures 6 et 7 représentent des vues respectivement en coupe transversale et de dessus d'un rotor pour le moteur selon l'invention. Le rotor (2) est formé par deux disques crantés présentant des dents décalées (81, 82) entre lesquels est positionné un aimant (83) aimanté suivant une direction perpendiculaire au plan médian du stator. Les dents (89 à 93) de l'un des disques crantés (81)

correspondent aux creux formés entre deux dents consécutives (94 à 98) de l'autre disque cranté (82). Chacun des disques crantés (81, 82) présente 5 dents séparées par 5 creux.

La figure 8 une vue en coupe transversale d'une autre variante de rotor. Le rotor comporte une bague (99) en un matériau magnétique doux, présentant dix zones (100 à 109) aimantées en festons de façon à présenter des pôles alternés à la surface de ladite bague (99).

l'invention est décrite dans ce qui précède à titre d'exemples non limitatifs. L'Homme de Métier pourra réaliser différentes formes de stator ou de rotor conforme à l'invention.

REVENDICATIONS

1 - Moteur diphasé formé par une partie statorique (1) excitée par des bobines électriques et par un rotor (2) aimanté, caractérisé en ce que le rotor (2) présente N paires de pôles aimantés radialement en sens alternés, N étant égale à 3 ou à 5, et en ce que la partie statorique (1) présente au moins deux circuits en forme de "W" (3, 4) comportant chacun une bobine électrique (20, 21) entourant la jambe centrale (5, 6), lesdits circuits en "W" (3, 4) étant disposés de façon à ce que lorsque l'une des jambes centrales se trouve en face d'une transition magnétique, l'autre jambe centrale se trouve en face d'un pôle magnétique, les épanouissements polaires des jambes d'un circuit en "W" étant espacées angulairement de $\pi/4$ et les épanouissements polaires des jambes centrales de deux circuits en "W" (3, 4) appartenant à des phases différentes étant écartées angulairement d'un angle sensiblement égal à $\pi/2 \pm k.\pi/N$, où N est le nombre de paires de pôles magnétiques, soit 3 ou 5 et k est égal à 0, 1, ou 2.

2 - Moteur diphasé selon la revendication 1 caractérisé en ce que deux circuits en "W" (3, 4, 51 à 54) présentent un épanouissement polaire commun (15, 65, 68, 71, 74).

3 - Moteur diphasé selon la revendication 1 ou 2 caractérisé en ce que les jambes extérieures des deux circuits en "W" (3, 4) sont reliés par un pontet (40) en forme d'arc de cercle.

4 - Moteur diphasé selon la revendication 3 caractérisé en ce que le pontet présente des dents statoriques (41 à 43) écartées de $\pi/4$ degrés.

5 - Moteur diphasé selon la revendication 1 caractérisé en ce que le stator est constitué par une pièce unique découpée pour présenter deux paires de circuits en "W" (3, 4) diamétralement opposés dont les épanouissements polaires sont équidistantes angulairement avec un pas de $\pi/4$.

6 - Moteur diphasé selon l'une quelconque des revendications précédentes caractérisé en ce que le stator (1) présente partie centrale évidée dont les dimensions permettent l'introduction d'une bobine électrique dans le plan des jambes et la mise en place autour de la jambe correspondante par translation.

7 - Moteur diphasé selon l'une quelconque des revendications précédentes caractérisé en ce que les jambes portant les bobines électriques s'étendent radialement.

8 - Moteur diphasé selon l'une quelconque des revendications précédentes caractérisé en ce que le stator est constitué par un empilement de tôles fines.

9 - Moteur diphasé selon l'une quelconque des revendications précédentes caractérisé en ce que l'extrémité frontale de l'épanouissement polaire est située dans le plan de la face frontale intérieur de la bobine.

10 - Moteur diphasé selon l'une quelconque des revendications précédentes caractérisé en ce le rotor (2) est formé par un aimant aimanté suivant une direction perpendiculaire au plan du stator (1) et placé entre deux disques crantés (81, 82) présentant des dents décalées.

11 - Moteur diphasé selon l'une quelconque des revendications 1 à 9 caractérisé en ce le rotor (2) est formé par une bague (99) aimantés en festons.

12 - Moteur diphasé selon l'une quelconque des revendications 1 à 10 caractérisé en ce qu'il présente une pièce auxiliaire de fermeture de flux.

13 - Moteur diphasé selon la revendication 12 caractérisé en ce qu'il comporte la pièce de fermeture du flux magnétique est une pièce cylindrique en forme de bague présentant des cannelures formant des dents placées en regard des dents statoriques.

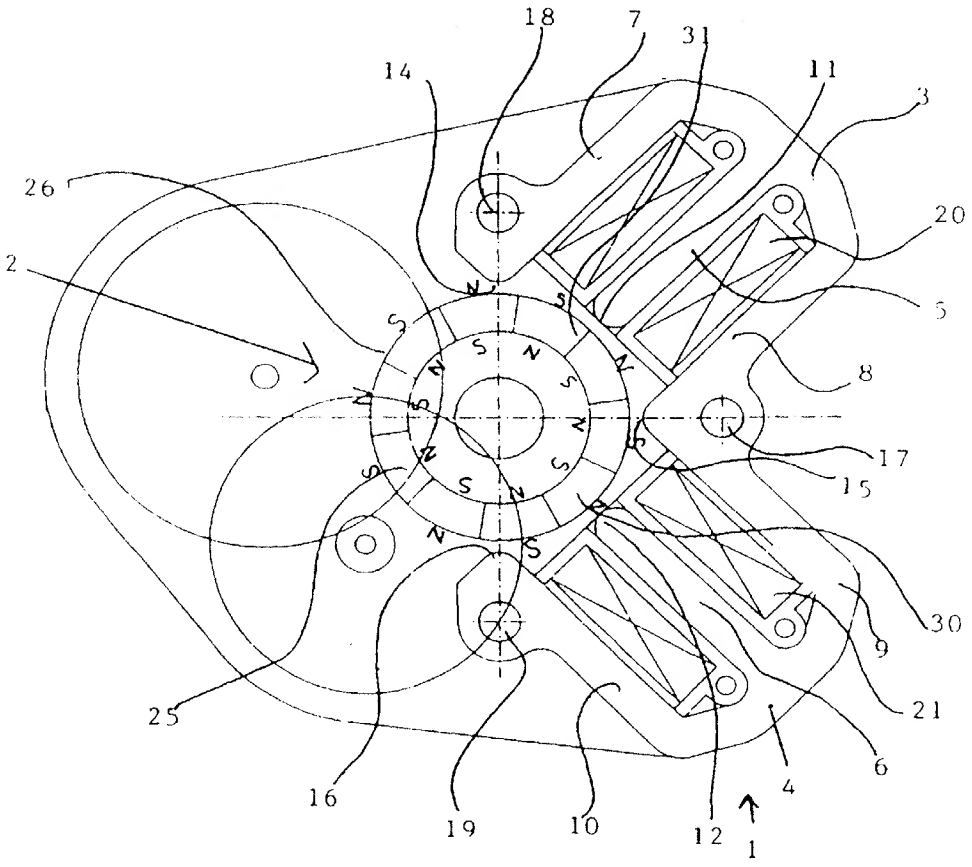


Fig. 1

Fig.2

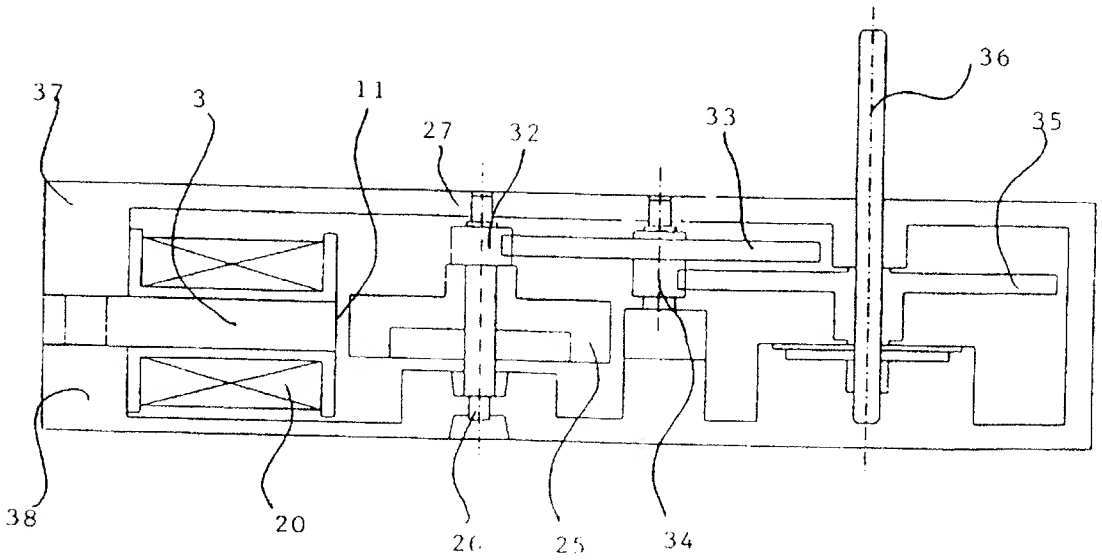
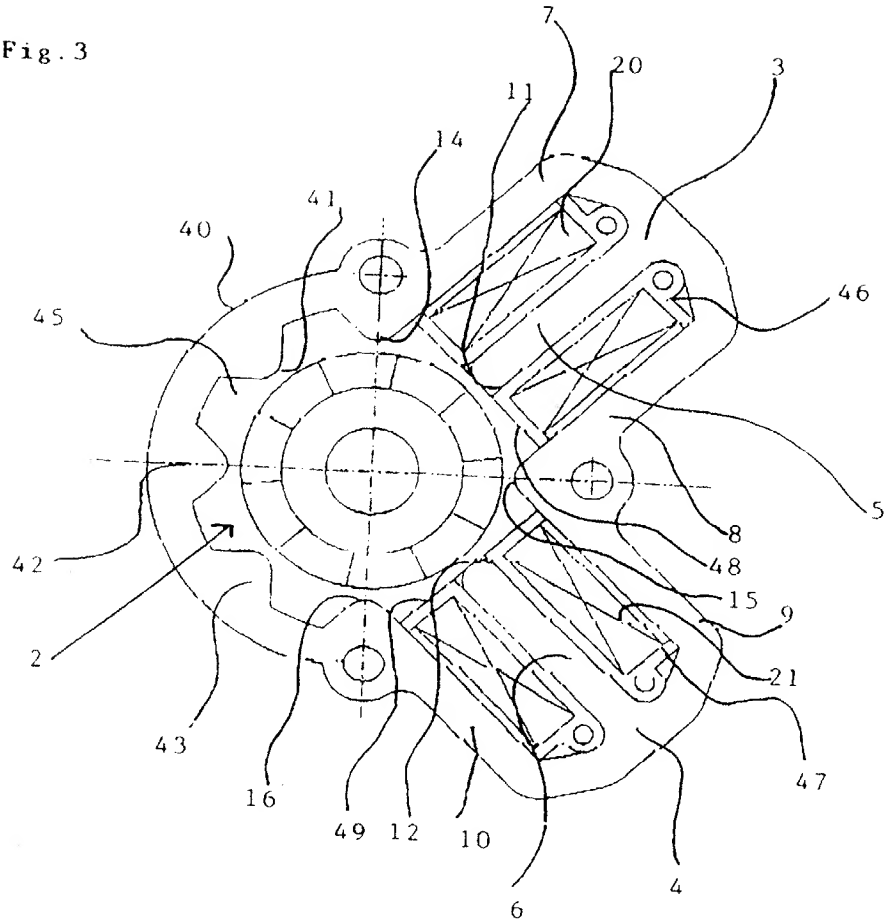


Fig. 3



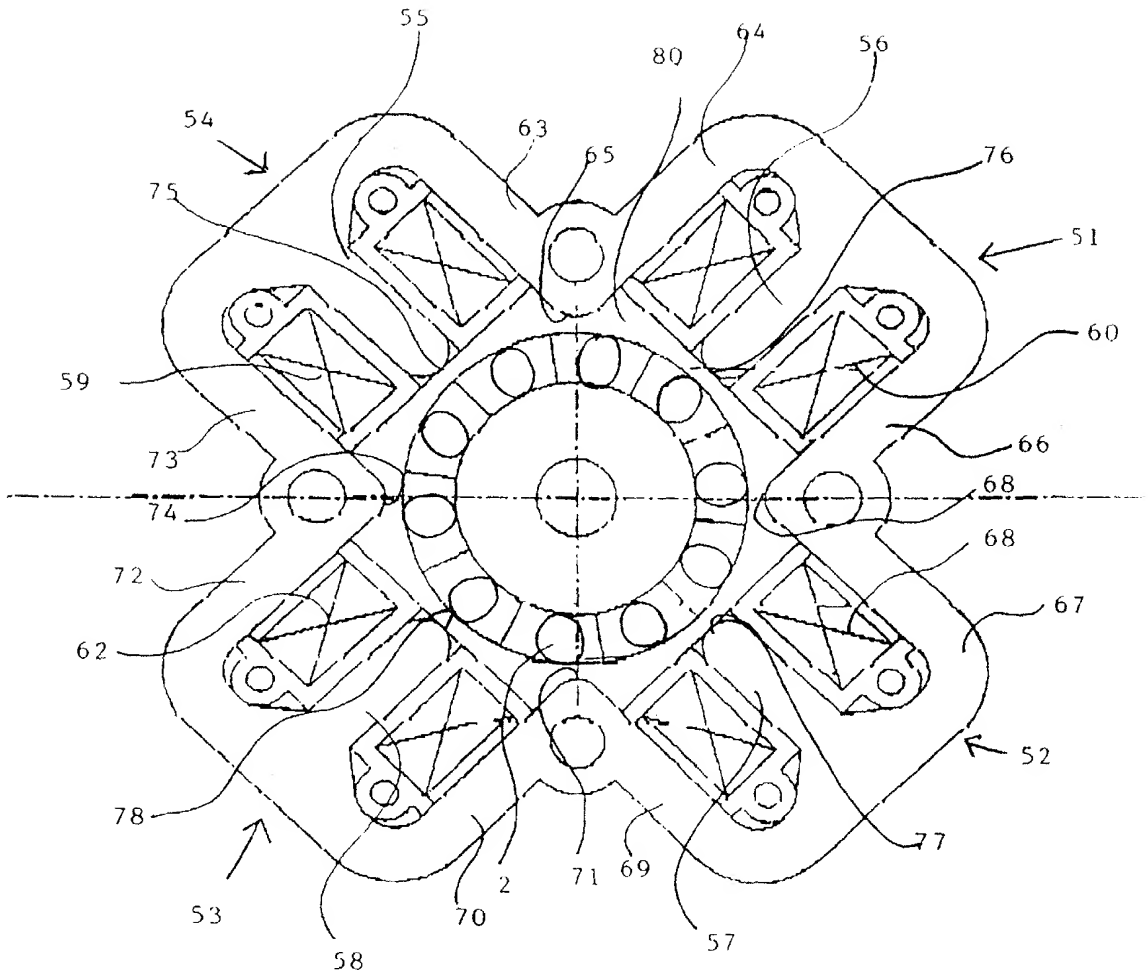

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Fig.5

Fig.6

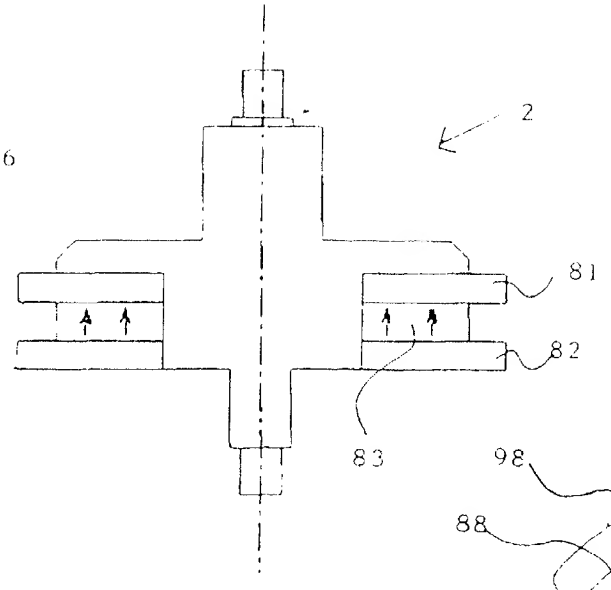


Fig.7

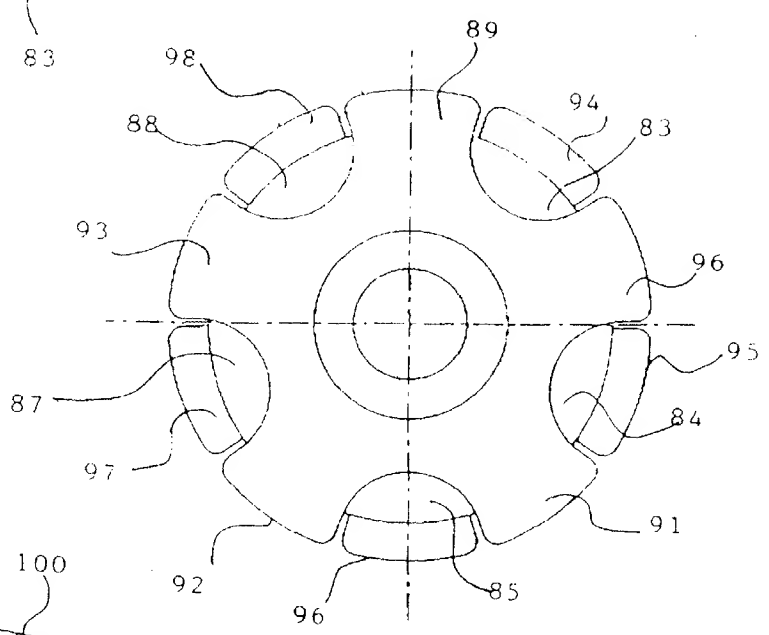


Fig.8

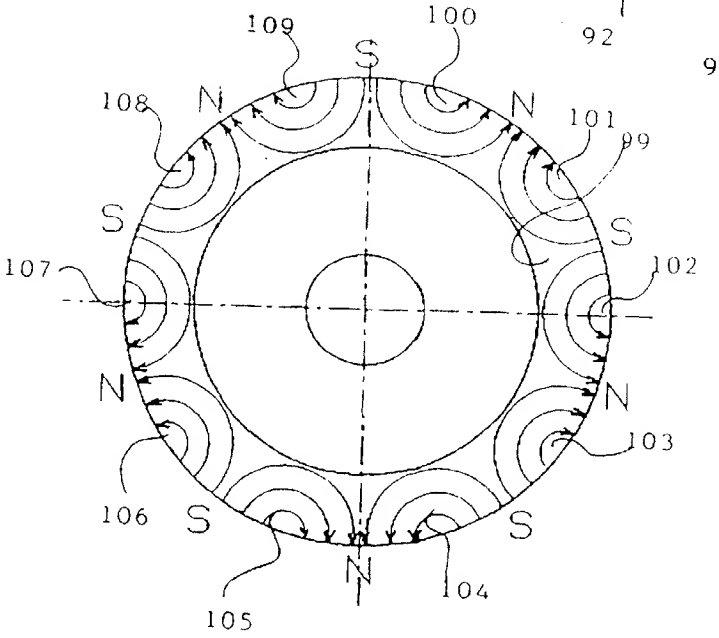
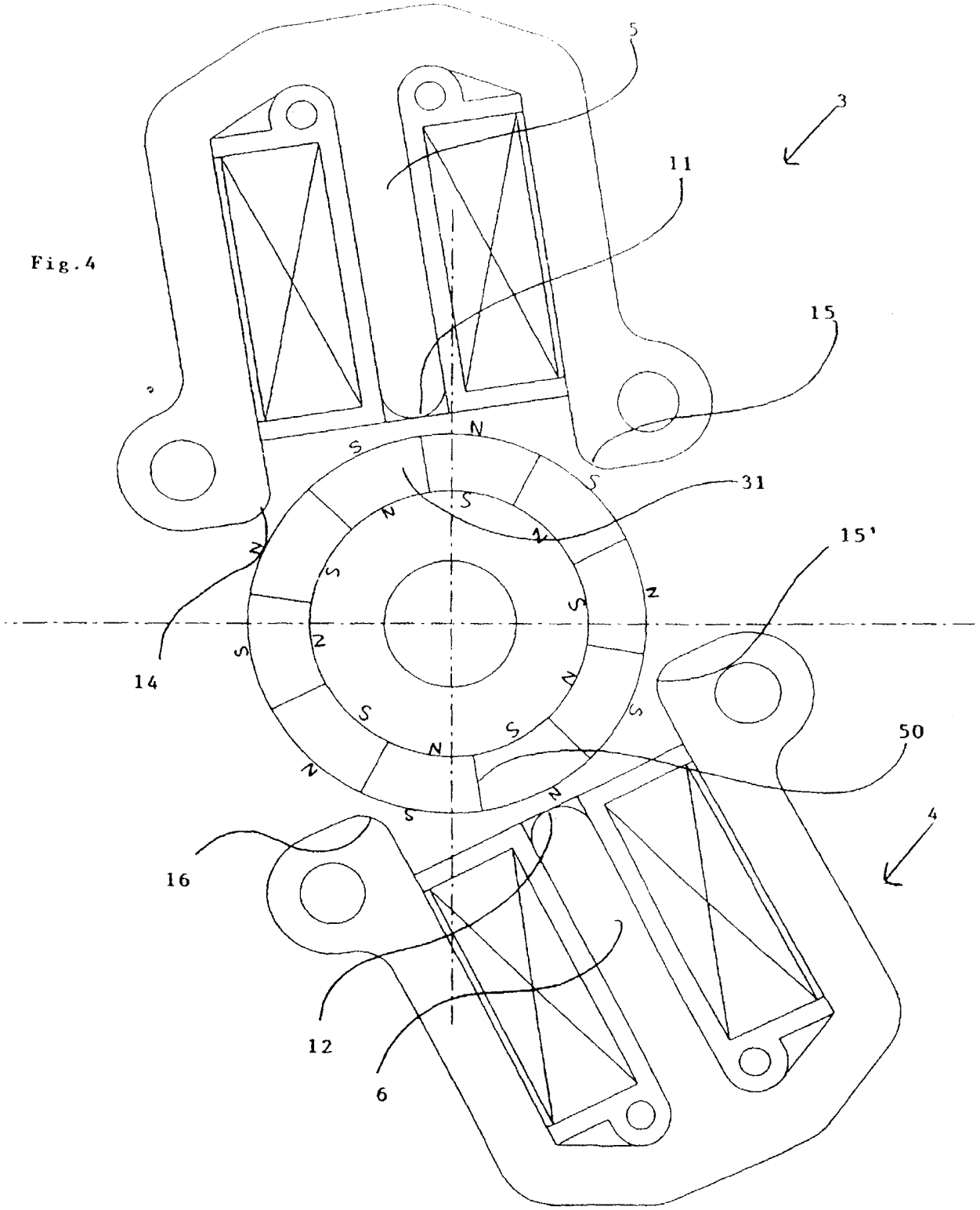


Fig.4



PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

BELLOMIA, P.
BUGNION S.P.A.
Via Vittorio Emanuele Orlando, 83
I-00185 Roma
ITALIE

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT
(PCT Rule 71.1)

Date of mailing *(day/month/year)*	07.11.2000
Applicant's or agent's file reference 11M210912WO3	**IMPORTANT NOTIFICATION**

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/IT99/00388	25/11/1999	28/01/1999

Applicant
MICRONASA DI PATARCHI ALBERTO et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/	Authorized officer
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Garvey, R Tel.+49 89 2399-2271

Form PCT/IPEA/416 (July 1992)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
11M210912WO3		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/IT99/00388	25/11/1999	28/01/1999
International Patent Classification (IPC) or national classification and IPC		
H02K37/14		
Applicant		
MICRONASA DI PATARCHI ALBERTO et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
27/07/2000	07.11.2000
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Drysdale, N Telephone No. +49 89 2399 2435

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IT99/00388

I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

1-11 as originally filed

Claims, No.:

1-16 as originally filed

Drawings, sheets:

1/5-5/5 as originally filed

2. The amendments have resulted in the cancellation of:

☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-16
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-16
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-16
	No:	Claims	

2. Citations and explanations

see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

V. Reasoned statement
2. Citations and explanations

1. Reference is made to the following documents:

   D1 = US 4 190 779 A
   D2 = US 4 864 199 A

   The document D2 was not cited in the international search report. A copy is appended hereto.

2. The claims on file do not satisfy the requirement of Art. 6 PCT because they are not clear - see Section VIII below. As far as they can be understood, however, the available documents illustrating the state of the art appear to provide no basis for an objection to the present claims on the grounds of lack of novelty or inventive step (Art. 33(2) & (3) PCT), while industrial applicability (Art. 33(4) PCT) is obvious for all claims.

3. The claimed invention appears to achieve a permanent magnet electrical machine with energy-saving control by providing a permanent magnet rotor and a stator with salient electromagnet poles, wherein essentially:
   (a) the stator poles are arranged in groups, with circumferentially adjacent groups offset angularly with respect to the rotor poles by a "polar step" (p) of half the span of a permanent magnet (claim 1) or a whole span (claim 5); and
   (b) the energising scheme of the stator poles leaves some poles de-energised so that the torque is provided by the attractive force between the rotor permanent magnets and the soft iron cores of the stator poles.

4. It is well known, particularly in the art of stepper motor control, to offset the stator poles by various amounts relative to the rotor poles - see, for example, document D1, Fig. 11. However, D2 is the only document known to the examiner which considers the effect of magnetic attraction between permanent magnet rotor poles (24-1) to (24-8) (Fig. 1) and the soft iron cores (32) of de-energised electromagnet poles (28-1) to (28-9) (see col. 8, lines 46-59). Even if a skilled person were to

consider combining the teaching of D1 and D2, the result would not be the subject-matter of present claims 1 and 5, which must therefore be considered as being novel and inventive (Art. 33(2) & (3) PCT).

The dependent claims define advantageous embodiments of the machine of claims 1 and 5. Their subject-matter is therefore also novel and inventive (Art. 33(2) & (3) PCT).

VII. Certain defects

1. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D1 and D2 is not mentioned in the description, nor are these documents identified therein.

VIII. Certain observations

1. The claims are very unclear and therefore do not satisfy the requirement of Art. 6 PCT. Before any entry into a subsequent regional phase the whole application, in particular the claims, requires revision in order that a skilled person may understand precisely what is included in the desired scope of protection and what is not. Non-standard terminology is used throughout the application, e.g. "polar expansions", "the input and output of the permanent magnets", "heteronomous", "complete (energy) cycle", in contravention of Rule 10.1(e) PCT (the preceding examples are not exhaustive).

2. Claim 5 is drafted as dependent on claim 1. However, as claim 5 specifies that the "polar expansions" are offset by a "double polar step", which is inconsistent with claim 1, claim 5 is, in fact, another independent claim.

3. It is unclear whether it is an essential feature of the claimed machine that the rotor permanent magnet poles should be **contiguous**, as illustrated in the figures, or whether adjacent poles can be separated along the rotor circumference. Associated with this point is the question of whether the "span" of a permanent magnet

refers to the angular extent of the pole or the pole pitch, i.e. the distance between corresponding points on adjacent poles. It is also unclear whether the separation of half of a permanent magnet span (claim 1) or a whole span (claim 5) is tied to a system with only **two** pairs of stator "polar expansions", as shown, or would also be valid for different numbers of pairs. The meaning of "opposite" in claim 10 is obscure. The expression "negative feedback" in the context of electromagnet excitation (claim 16) is obscure.